



**INCLUSIVE EDUCATION  
INITIATIVE**

# A Landscape Review of ICT for **Disability-Inclusive Education**

January 15, 2022





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# abbreviations

<b>AAC</b>	augmentative and alternative communication
<b>AI</b>	artificial intelligence
<b>AP</b>	assistive products
<b>APL</b>	Priority Assistive Product List
<b>ARATA</b>	Australian Rehabilitation and Assistive Technology Association
<b>AT</b>	assistive technology
<b>COVID-19</b>	coronavirus disease 2019
<b>CRPD</b>	Convention on the Rights of Persons with Disabilities
<b>DPE</b>	Directorate of Primary Education
<b>EARC</b>	Educational Assessment and Resource Center
<b>EdTech</b>	Education and Technology
<b>EMIS</b>	Education Management Information Systems
<b>ICT</b>	information and communication technology
<b>IEI</b>	Inclusive Education Initiative
<b>KBTA</b>	Kilimanjaro Blind Trust Africa
<b>LMIC</b>	low- and middle-income country
<b>MAG</b>	Microsoft Academic Graph
<b>OPD</b>	organizations of persons with disabilities
<b>REB</b>	Rwanda Education Board
<b>SPIP</b>	Social Protection Investment Plan
<b>UDL</b>	Universal Design for Learning
<b>UNESCO</b>	United Nations Educational, Scientific, and Cultural Organization
<b>UNICEF</b>	United Nations Children's Fund
<b>WHO</b>	World Health Organization



Source: Inclusive Education Initiative, World Bank.

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# executive summary

Information and communication technology (ICT) tools can have a catalytic effect in advancing both educational access and learning outcomes for children with disabilities.

Despite tremendous potential, a gap exists between technology advancements and their large-scale application in educating children with disabilities in low- and middle-income countries. This landscape review of ICTs for disability-inclusive education by the Inclusive Education Initiative seeks to understand the current status and trends in the practice of educational technology (EdTech) and the use of ICT in improving the educational participation and outcomes of children with disabilities. The review explores what factors enable or restrict this improvement within the wider EdTech ecosystem.

Since early 2020, the COVID-19 pandemic required governments around the world to pivot to remote or distance learning with high emphasis on EdTech interventions. The review explores how ICT supported the continued learning of children with disabilities during pandemic-related school closures. It shares insights from the experiences of multiple stakeholders, including teachers, parents and caregivers, government officials, and civil society in delivering accessing digital learning solutions for children across the spectrum of disabilities. Global insights were supplemented with country case studies in Bangladesh, Ethiopia, Kenya, Nepal, and Rwanda to draw out

examples of what is and is not working and how COVID-19 has impacted learning for children with disabilities.

## Assessing the ecosystem through the 6 P's

While technology alone cannot solve learning gaps by itself, it is vital to supporting the learning outcomes of children with disabilities.

The level of access and the impact of ICT for inclusive education depend on various interconnected factors. The insights and findings that emerged from the primary and secondary research conducted in this study reflected the themes identified by the 6 P's education systems framework: people, products, pedagogy, policy, place, and provision. This framework is used to summarize the essential components of the entire EdTech ecosystem, identify what is and is not working, and how each part is necessary for the others. The review identified six key challenges that need to be overcome to ensure that learners with disabilities are fully able to access and benefit from ICT for inclusive education.

### 🕯 People.

Teachers, parents, and other educational support figures lack sufficient expertise in inclusive education and ICT and access to supports to successfully support children with disabilities to access and take advantage of EdTech.

### 🕯 Products

Most EdTech devices and software are too expensive for families and schools, limiting their affordability and accessibility. Many products also fail to be truly inclusive of

children with more complex needs, are poorly aligned with national curricula or are inappropriate for the context of use.

### 🎯 Pedagogy

There is a lack of understanding about the useful pedagogical approaches and simple and reliable assessment practices to assess the educational needs of children with disabilities, or what pedagogical approaches (and tools) will be most effective. Nor are there often mechanisms in place for monitoring their progress to ensure that any adaptations, including technology provided, positively impact their learning experiences.

### 🎯 Policy

Existing policies for inclusive education and ICT are often separate and poorly integrated, which makes it difficult to coordinate actions across government bodies with fragmented responsibilities and between actors working in different areas.

### 🎯 Place

Inclusive and mainstream schools struggle to access the necessary equipment that students with disabilities need, and teachers are often lacking the inclusive-education training, which leads to a risk of further marginalization of students with disabilities.

### 🎯 Provision

Funding mechanisms for initiatives focusing on ICT for inclusive education are often project-based and rarely combine a comprehensive attention to all the necessary components of successful implementation from creating adequate technological infrastructure to providing training and maintenance for the correct use of devices. This leads to poor sustainability of many initiatives and reduces the potential impact of many implemented projects. A vital aspect of provision is procurement.

## **A multidimensional approach with more human engagement to boost human capital**

Globally, a shift in perspective is required to embrace EdTech as part of an inclusive learning framework that is contextually specific and can support the inclusive education of children with disabilities.

There is no one single “magic bullet” solution. A multidimensional and integrated approach that puts the child at the center is needed. Additionally, the successful application of ICTs for inclusive education requires concerted investments in scaling the skills, knowledge, and capacity of the human stakeholders engaged in the selection, purchase, application, and use of technologies for children with disabilities.





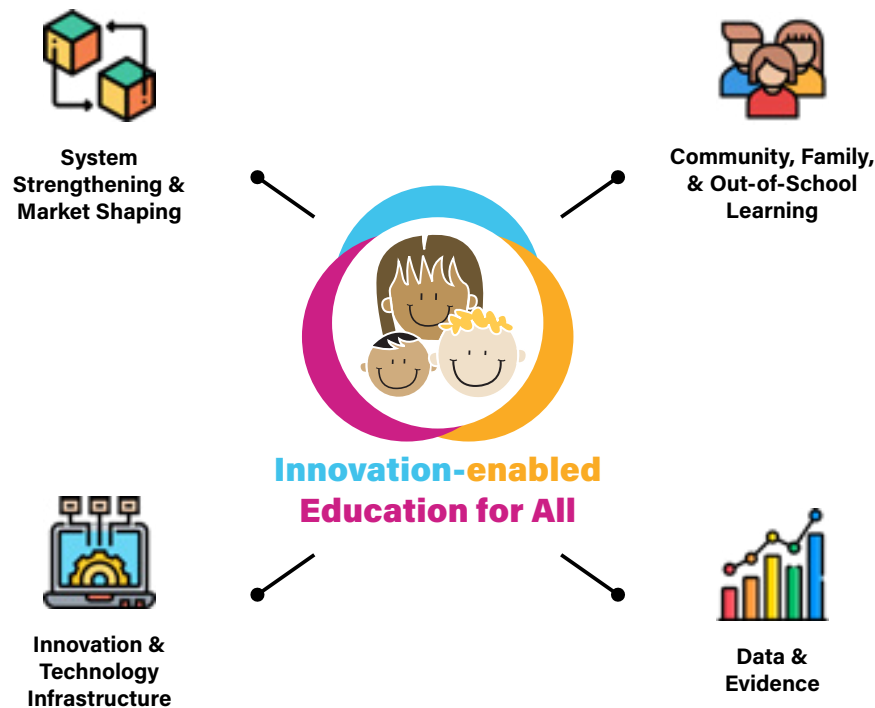
Source: Inclusive Education Initiative, World Bank.

The way in which interventions for improving access and impact of ICT for inclusive education are delivered also matters. Adopting a twin-track approach with targeted disability-specific work is vital and necessary, alongside mainstream interventions that adopt inclusive approaches. For instance, the mainstream programs around inclusive education or innovation need to work as hard for learners with disabilities as the disability-specific interventions, which should be used to trial and test learning that can be adopted in the mainstream. This effort will necessitate client-side disability expertise on mainstream projects where large procurements or investments are made. It is important to forge disruptive partnerships to engage new and different actors to support innovation. Involving and including learners with disabilities and their families, communities, and teachers throughout the planning and delivery of any intervention are crucial to the successful delivery of disability-inclusive EdTech programs. The interventions that are working are small, but creative consideration

of how to grow this distributed delivery on a massive scale is possible—a “massive-small” approach.

This report recommends an Innovation-Enabled Education For All approach that incorporates four interconnected components that are crucial for harnessing the potential of educational and assistive technology (AT) into tangible and successful learning outcomes for children with disabilities. They are: (i) systems strengthening and market shaping; (ii) community, family, and out-of-school learning; (iii) open innovation and technology infrastructure; and (iv) data and evidence. Each component cuts across the 6 P’s of educational systems. Effective actions will require cross-sector collaborations between stakeholders working across the entirety of the ecosystem that places the child at the center. Figure ES.1 shows the four components within the multidimensional and integrated Innovation-Enabled Education For All approach.

**FIGURE ES.1: The multidimensional and integrated Innovation-Enabled Education For All approach**



Source: World Bank.

The report makes a series of recommendations around these four components aimed at governments, education practitioners, development practitioners, and donors. They are discussed in detail in chapter 8 and summarized here.

## RECOMMENDATION 1

**Strengthen systems and shape markets to systematically improve the provision of inclusive education and reduce the cost of assistive ICT for inclusive-education products.** Actions to consider are the following:

- Developing ICT for inclusive-education product guidance to support the procurement and purchase.
- Investing in and develop country-, subnational-, and local-level tools to assess current country capacity, procurement, and need for ICT for inclusive-education products.
- Developing ICT for inclusive-education training guidance (beyond, but including, products) for countries, schools, caregivers, and community education leaders.
- Enhancing ICT for inclusive-education policy and crucially its implementation by providing further technical assistance at the country level.

- Supporting teachers and other education providers in delivering inclusive educational experiences through pre-service and in-serving training, learning packages, and resource tools.

## RECOMMENDATION 2

**Develop a “massive-small” technology and service infrastructure for inclusive education to enable massive-scale distribution of evidence-based, small-scale innovations.** This can be accomplished through:

- Driving innovation in ICT for inclusive education by raising awareness of it as an investment space, creating public-private partnerships between unusual and disruptive actors, and raising awareness of new markets and services.
- Designing and testing novel funding mechanisms to support existing innovators who respond to the need to support massive-small initiatives.
- Incentivizing open innovation through entrepreneurial ventures and innovations, matchmaking between policy makers, purchasers, and producers of technology and services, and strengthening country supply chains.

## RECOMMENDATION 3

**Strengthen community, family, and out-of-school learning supports to ensure continuity of learning across different settings.** This can include actions to:

- Shifting provision mechanisms to ensure that the technology is associated to the child rather than the school to help children learn outside of school without replacing efforts to keep children in school.

- Opening up training and support mechanisms to community leaders and caregivers to facilitate the provision of education outside the school when needed.
- Working with parents, caregivers, children, and representative organizations to ensure they are involved in identifying the need for, and development of, Ed-Tech that is intended for their use.
- Developing clear multidisciplinary referral structures for early identification and screening of functional difficulties and access to required services.
- Collecting and sharing case studies of good practice of community- and family-led schooling, and consider what platforms are needed to support that.

## RECOMMENDATION 4

**Capture better data and evidence vital to policy making, identification of learners, early intervention, and mapping of progress.** Initiatives to support this could include:

- Enhancing coordination and linkages between existing identification mechanisms and service delivery systems to develop better identification and screening tools for children with disabilities.
- Strengthening the use of data from Education Management Information Systems both as a tool for future planning, including the type of EdTech that might be required at the classroom level, and as an entry point for identifying children who may need EdTech support.
- Digitizing data collection processes to facilitate visualization and sharing.
- Building the global evidence base to address research and knowledge gaps

on the use and impact of EdTech on the outcomes of children with disabilities, including in comparison to their peers and classmates without disabilities.

**Finally, the recommendations have been extrapolated from the data and are naturally top-level strategic proposals.**

To implement these recommendations, additional contextualization will be required to bring them to life in the local, national, and regional context. In keeping with other similar approaches, such as the AT tools from the Global Cooperation on Assistive Technology initiative, specific technology

requirements, and the prioritization of these, are subject to discussion and debate with key stakeholders at a country level. Tools can support this step, as can overarching prioritized technology lists. Although the scope of this research was not intended to deliver either, this could be a next step identified under the recommendations. Local innovation mapping and data collection will also be helpful in supporting local implementation along with community engagement. In short, the components of the recommendations will all warrant discussion in context in order to facilitate local-level priorities for implementation.



Source: Marie Schoeman, Leonard Cheshire.





# 01

## introduction

While the increased focus on universal basic education over the past few decades has led to progress against global goals, including Sustainable Development Goal 4, it has not been matched by gains in the quality of education or improved learning outcomes.

Source: World Bank.

**Millions of children continue to be excluded from school for a variety of reasons, and children with disabilities are particularly disadvantaged despite efforts to address their exclusion (World Bank 2020a).**

The impacts of this exclusion are felt across their life course. This report is part of the World Bank's global effort to promote equitable and lifelong opportunities for all. It aligns with the Ten commitments on disability-inclusive development, which includes, among other relevant topics, inclusive education, technology and innovation, disaggregated data, girls with disabilities, and the World Bank's Disability Inclusion and Accountability Framework (World Bank 2018a). The research presented in this report also aims to complement existing evidence gathered by the World Bank on inclusive education and the role of technology in education (World Bank 2020a,c; World Bank 2021).

According to the Global Education Monitoring Report of the United Nations Educational, Scientific, and Cultural Organization (UNESCO), there are three main areas in which children with disabilities are being left behind due to unequal education opportunities. First, children with disabilities are simply left out of the school environment. Second, children with disabilities are failed within the classroom. This is demonstrated in both lower completion rates and decreased educational attainment (UNESCO 2020, 4). Finally, many impairments go undetected in children (and adults) due to lack of assessment and specialist knowledge. The impacts of this are reduced linguistic, social, and cognitive development (Sass-Lehrer, Porter, and Wu 2016). Gender and other intersectional

identities play a significant part in access to education for many children with disabilities, with girls, refugees, and members of ethnic and linguistic minorities more likely to face further marginalization and exclusion from school or to be less likely to transition through the education system (Tauson and Stannard 2018; Dhaya 2016; UNESCO 2020).

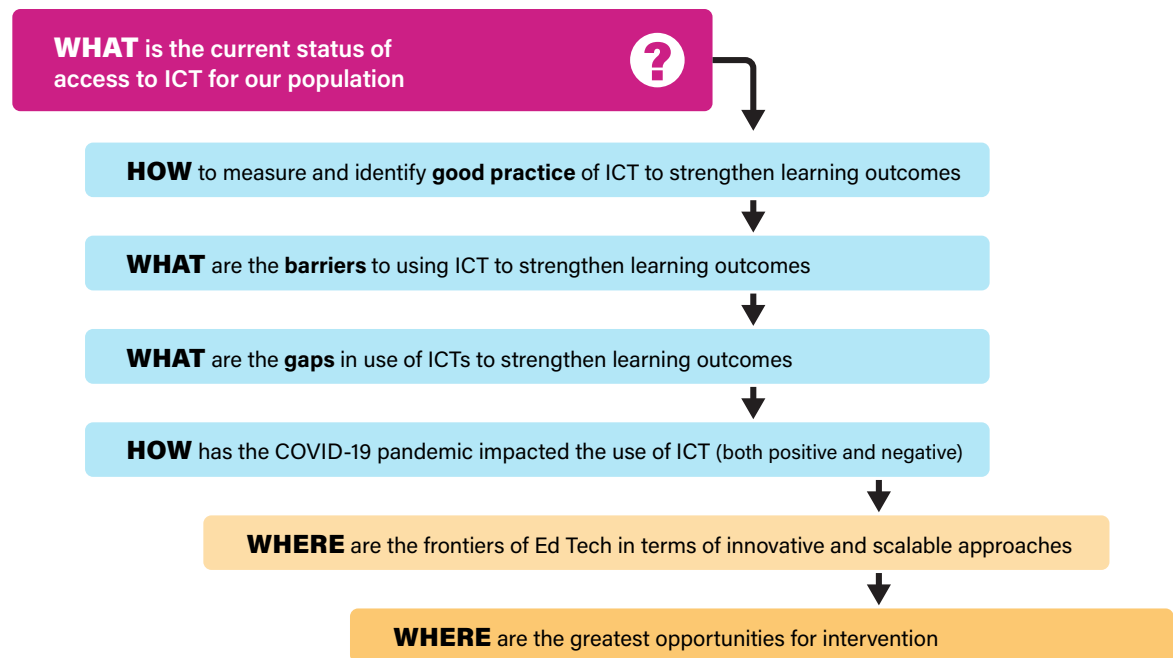
Even before the COVID-19 pandemic an equity gap existed within education for children with disabilities (World Bank 2020a). Education technology (EdTech) has been hailed as a key mechanism to address these learning gaps, though is not without challenges or unintended consequences (Muyoya, Brugha, and Hollow 2016). However, technology needs to be used with appropriate pedagogy and be personalized to accommodate students' differing and sometimes conflicting needs (i.e., teaching to the right level). Yet this is rarely done as teachers have not been trained to identify appropriate accommodations, and in low- and middle-income countries (LMICs), the lack of infrastructure exacerbates these challenges (UNESCO 2020, 120). However, as noted by a recent rapid scan by the Ed-Tech Hub, data on infrastructure is very limited in the first place in many countries, so it is difficult to determine what is available (Taddese 2020). According to the United Nations Secretariat, while accessible ICT has been promulgated since 2003, several barriers have impeded this, particularly in LMICs, where only 66 percent of primary schools have electricity. Only 32 percent of primary schools in Sub-Saharan Africa have access to electricity, the lowest level in the world (United Nations Secretariat 2021, 5). The ongoing COVID-19 pandemic has only heightened existing gaps in provisions and mobilized technology-based responses in many countries.

## purpose of report

The objective of this landscape review by the Inclusive Education Initiative (IEI) is to understand the status and trends in the use of digital technologies to support the educational participation and learning outcomes of children with disabilities.<sup>1</sup>

It incorporates desk-based and empirical findings from discussions with key stakeholders and interviewees, as outlined in chapter 2 on methodology, to address the research question: Can ICT improve the learning outcomes of children with disabilities in LMICs, and what factors enable or restrict this improvement within the wider EdTech ecosystem? In addition to the overarching question, a series of sub-questions are included (see figure 1).

**FIGURE 1:** List of sub-questions to guide primary and secondary research



Source: World Bank.

The research specifically focused on primary level education in five priority countries: Bangladesh, Ethiopia, Kenya, Nepal, and Rwanda. It has sought to address some of the shortcomings related to lack of available evidence around the use of EdTech to support learners with disabilities (Lynch, Singal, and Francis 2021). Specifically, it aims to understand

<sup>1</sup> For more information about the Inclusive Education Initiative, visit its website at <https://www.inclusive-education-initiative.org>.





the extent to which the increasing use of ICT in education is contributing to improved learning outcomes for children with disabilities in LMICs (Hennessy et al. 2021), and to identify the factors that are enabling or restricting these improvements within the wider EdTech ecosystem.

To do this in a consistent and comparable way, the research utilized the 6 P's framework, which in turn built on the 5Ps framework developed by the Global Cooperation on Assistive Technology (GATE). GATE is a partnership between a range of stakeholders, including international organizations, donor agencies, professional organizations, academia, and user groups, led by the World Health Organization (WHO), to realize the obligations of the Convention on the Rights of Persons with Disabilities toward increasing access to AT.<sup>2</sup> GATE identified five priority system-wide themes necessary to achieve these aspirations, which were summarized into 5 P's: people, products, provision, personnel, and policy. These are interlinked, with people (users, their families, and communities) at the center (Holloway et al. 2018, 9).

The EdTech Hub took this systems approach and applied it to their work, adding a sixth, more education-specific one—pedagogy. They note that the 6 P's framework allows a consistent approach to the evaluation of EdTech solutions, while also allowing for the “complexity involved in innovating within education systems” (Plaut et al 2020, 7). Therefore the review's findings are structured around the 6 P's framework to assist the reader in identifying the strengths and weaknesses of specific components of the EdTech ecosystem.

## The overall report is structured as follows:

**Chapter 1** sets out the approach to the research, including the definitions and framing of the research questions.

**Chapter 2** focuses on the methodology adopted for the various stages of research, including the thematic literature review, online survey, artificial intelligence (AI) scanner, in-country interviews, and consultation with experts in the field.

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<sup>2</sup> For more information about the Global Cooperation on Assistive Technology visit WHO's website at [https://www.who.int/news-room/feature-stories/detail/global-cooperation-on-assistive-technology-\(gate\)](https://www.who.int/news-room/feature-stories/detail/global-cooperation-on-assistive-technology-(gate)).



**Chapters 3–5** present the results generated by research carried out, focusing on the global situation in relation to access and impact of ICT for inclusive education. They cover the literature review, Global Survey on Information and Communication Technology for Disability-Inclusive Education, and the AI-powered media and academic article research study.

**Chapter 6** presents the findings from the in-country key stakeholders interviews conducted with government stakeholders, practitioners, activists, and parents and caregivers in the five countries, using the 6 P's framework. It also highlights the challenge to accessing ICT for inclusive education, which was identified as a priority by global experts during the modified Delphi exercise.

**In chapter 7** findings are drawn together into the discussion and explore how they fit with work across the World Bank portfolio, particularly in inclusive education. This research identifies several potential innovative and scalable approaches and opportunities in EdTech to improve learning outcomes for children with disabilities. They are based around the idea of innovation-enabled education for all.

**Chapter 8** provides a set of recommendations based on conclusions.

Recommendations have been extrapolated from the data and are naturally top-level strategic proposals. To implement them, additional contextualization will be required to bring this to life in the local, national, and regional context. In keeping with other similar approaches, such as WHO's GATE initiative, specific technology requirements are recommended. Their prioritization are subject to discussion and debate with key partners at the country level. Tools can support this, as can overarching prioritized technology lists. Although this research was not in scope to deliver either, this could be a next step identified under the recommendations. Local innovation mapping and data collection will also be helpful in supporting local implementation—along with community engagement. In short, the components of the recommendations will warrant discussion in context to facilitate local-level priorities for implementation.

## definitions & concepts

Inevitably there are overlaps in use and understanding of the range of terms around technology and education, including EdTech, information and communication technology (ICT), Universal Design for Learning (UDL), as well as overlaps with assistive technology (AT) and assistive products (AP), more broadly.

While some might view ICT as a subset of AT, others might view it as a subset of EdTech. AT and EdTech are ecosystems needed for learners to integrate the products (ICT and AP) into their learning experience for maximal benefit.

Within this report, the concept of EdTech, elaborated by the World Bank, is leveraged as an ecosystem approach that includes the software, hardware, internet application, and activities necessary to support and enrich learning (Hawkins et al. 2021). In the context of inclusive education and in line with the UDL approach, EdTech can encompass mainstream educational technologies (including hardware devices and software designed using universal access standards or featuring built-in accessibility features), purposefully designed ICT for persons with disabilities (including physical hardware and digital software and mobile applications to enhance functional access to content and communication), and adapted teaching and learning materials that change how content is delivered and disseminated.

In light of this, both the concept of AP, which includes devices, equipment, instruments, or software used to support persons with disabilities, and one of AT systems, which enable access to these products, greatly overlap with the concept of EdTech, within the context of inclusive education of children with disabilities.

Another concept leveraged in the research is UDL. It is defined by CAST as an approach to education research and design that uses three core principles: providing students with multiple means of representation; providing multiple means of action and expression; and providing multiple means of engagement.<sup>3</sup>

Finally, rather than focusing on specific conditions, a broad rights-based definition of disability is used from the WHO and the Convention on the Rights of Persons with Disabilities (CRPD). “Disability results from the interaction between persons with impairments and attitudinal and environmental barriers that hinder their full and effective participation in society on an equal basis with others” (WHO 2011). This conceptualization allows a pan-disability perspective to make this research as comprehensive and inclusive as possible. At times, examples from literature or insights from key informants do focus on a particular type of impairment. However, in line with the CRPD and the goals of a fully inclusive-education system that focuses on the inclusion of all learners, the landscape review emphasizes a set of principles around EdTech for children with disabilities, rather than a specific piece of hardware or software for a child.

This approach was chosen for two reasons. In addition to the point of principle, focus on individual disabilities will not necessarily lead to the system transformation required to ensure the inclusion of all children with disabilities. Those with the most complex needs or least prevalence will inevitably be left behind. This is also in line with the recommendation for further contextualization at a country level. It should not dissuade country-level investigation into product and service prioritization that, as is shown through the WHO’s Priority Assistive Product List (APL) for AT, is necessary and relevant as part of a suite of country-level tools and tactics.

**A full list of the definitions and concepts used in this report is provided in appendix A.**

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3 For more information about Universal Design Learning, visit the CAST website at <https://www.cast.org/impact/universal-design-for-learning-udl>.

# 02

## methodology

Chapter 2 provides a summary of the methodology used in this report, with the full detail provided in appendix B. Findings and recommendations were gathered using a combination of different methods including:

- a literature review of available evidence;
- six expert roundtable discussions using an adapted Delphi approach;
- a global digital survey of stakeholders;
- an AI-powered media search; and
- country-level key informant interviews in the five countries.

Junior Onango using learning materials and toys in class in Kenya. Leonard Cheshire/Hamish Roberts.

The review of literature conducted focuses primarily on the country-level literature and includes 80 relevant articles and 20 reports. Findings are structured around the three key conditions that Banes et al. (2020) recommended must be in place for the successful application of a UDL framework, and in turn achieve equity and inclusion of all children within the education system. These are:

- identify children with disabilities (using at a minimum the Washington Group questions);
- assess and understand the educational system in terms of capacity of policy, infrastructure, and educators to support the learning of children with disabilities; and
- provide affordable, accessible AT (must be identified and assessed appropriately).

The full report of the literature review is available upon request from the authors.

The anonymous online survey was designed to elicit responses around availability, access, and experiences concerning the use and impact of ICT for inclusive education from a range of respondents. The survey was conducted online in English between May 10 and May 25, 2021, and received 226 responses.

This AI-powered media and academic article research study was designed to understand the research trends and identify media interest around ICT for inclusive education. Two searches were completed. The first search combed the academic literature using the Microsoft Academic Graph (MAG). The second search was of media articles and uses the infrastructure

that powers Event Registry, which analyses news articles. The time period of media articles was limited to 3 years, from 2018 to August 2021. A preliminary analysis of these data is reported and covers overall trends in both databases, with additional analysis of the geographic spread.

Semi-structured interviews with key informants from a variety of organizations were carried out across the five countries. These included relevant government ministries and agencies, such as ministries of education, information and communication technologies, and social welfare; local government; nongovernmental organizations (NGOs) and international NGOs; organizations of persons with disabilities (OPD); donor agencies; academia; private ventures and start-ups; and teacher and parent groups. Interview questions covered an organization's ongoing activities to support the inclusive education of children with disabilities; awareness of relevant policy frameworks; evaluation mechanisms to assess the inclusion; collaborations with national and international partners; and experiences during the ongoing COVID-19 pandemic.

Seventy-five interviews across the five countries were carried out between May 14 and August 13, 2021. Data were analyzed using an inductive approach that resulted in the conceptualization of 12 themes. To facilitate presentation and enable a more comprehensive understanding of the strengths and weaknesses of different components of the education ecosystem, these themes were organized according to the 6 P's framework (see figure 2). The phrasing of questions in the original framework were slightly adapted in this landscape review to fit the aim of unpacking the complexity of developing and deploying



**EdTech to support inclusive education for learners with disabilities at a primary school level, as follows:**

- People—Who are the stakeholders involved in the development, deployment, and use of ICT for inclusive education?
- Products—What kinds of ICT for inclusive education is developed and used, and what are the procurement mechanisms for it?
- Pedagogy—On which pedagogical principles is ICT for inclusive education built?
- Policy—How do existing policy frameworks influence ICT for inclusive education?
- Place—Where is ICT for inclusive education used?
- Provision—How is ICT for inclusive education funded, and how sustainable are current provision models?

**FIGURE 2: Education System 6 P's Framework Diagram**



Source: Plaut et al. 2020.

To elicit expert opinions from across a range of sectors and to ensure consensus around findings, four focus group discussions were undertaken with 23 World Bank staff, including task team leaders of Bangladesh, Ethiopia, Kenya, Nepal, and Rwanda. Additionally, two online round-table discussions with 24 selected global experts in the fields of inclusive education, educational technologies, and disability were completed using a modified Delphi approach in order to illicit stakeholder views and build toward a consensus.

The study has some limitations. The first is that it only focuses on five countries. Although it provides diverse examples, it is not robustly representative of the entire global picture. A second limitation is that the secondary research was undertaken in English, reflecting a predominance of English-language resources in the literature. Thirdly, both the global survey

and the country-specific key informant interviews were conducted remotely due to the ongoing pandemic, meaning that only people who had access to the internet or a phone line could be involved in the research. In the case of the key informants interviews, the research was conducted with the support of local consultants who leveraged phone calls as well as emails to reach out to participants. A small number of interviews were conducted in person, according to local COVID-19 regulations in place at the time, or over the phone where possible. This may have mitigated some selection bias. The global survey was only conducted through the use of a digital platform. It is also noteworthy that the political situation in Ethiopia resulted in very limited access to officials. Finally, it should also be noted that the EdTech field in particular is a rapidly evolving one. Evidence was up to date when the review was written, but it will inevitably continue to evolve.



Source: Disability-Inclusive Education in Africa Program. World Bank.





# 03

## global context

This chapter provides an overview of the literature and sets the context for the remainder of the review.

The themes emerging from the literature review supported the design, topics, and methods of the primary research. In particular, it provided a framework for the country-level investigation. A much longer review by country was undertaken. The key themes are summarized here.

Source: Shutterstock.

## how can EdTech support inclusive education?

Technology can be a tool to enable teachers to support learners with a diverse range of backgrounds, skills, capabilities, languages, and impairments.

However, it is clear that their current training inadequately prepares them to do this. UDL might offer a way to bridge these gaps, but will require a rethink in the way teachers are taught, children are assessed, and parents and caregivers are engaged, as well as more research and evidence of impact on learning outcomes (McKenzie et al. 2021, 52). Unfortunately, to date, there is very little evidence about the implementation and impact of UDL in LMICs (McKenzie et al. 2020). A recent review makes recommendations to better support UDL approaches in LMICs, including the need to ensure engagement with teachers, families, and the range of technology available. However, the authors caution against over-emphasizing the technology aspect, as this may deter many LMICs from using an approach that could otherwise benefit many students. Finally, they note a number of conditions that need to be in place to ensure students do reap the benefits, particularly teacher capacity and leadership, relevance to context, and creative ways to assess students learning (McKenzie et al. 2021, 52–53).

While the need to apply UDL using a mix of accessible and AT to support children with disabilities students has been well documented (Banes et al. 2020, 7), how to operationalize UDL is less well documented and less well evidenced. The aims of UDL

align with the global inclusive-education agenda as they support a learner-centered education system, with technology (EdTech) playing an essential function within this approach.

These issues are addressed in the World Bank paper outlining its approach to EdTech. Hawkins et al. (2021, 7) list five fundamental principles as follows:

- Principle 1: Ask Why? EdTech policies and projects need to be developed with a clear purpose, strategy, and vision of the desired educational change.
- Principle 2: Design and Act at Scale, For All. The design of EdTech initiatives should be flexible and user-centered, with an emphasis on equity and inclusion, in order to realize scale and sustainability for all.
- Principle 3: Empower Teachers. Technology should enhance teacher engagement with students through improved access to content, data, and networks, helping teachers better support student learning.
- Principle 4: Engage the Ecosystem. Education systems should take a whole-of-government and multi-stakeholder approach to engage a broad set of actors to support student learning.
- Principle 5: Be Data-Driven. Evidence-based decision-making within cultures of learning and experimentation, enabled by EdTech, leads to more impactful, responsible, and equitable uses of data.

These are clustered around the “connected learner” (see figure 3).

Hawkins et al. (2021) set out a roadmap for implementing these five principles,

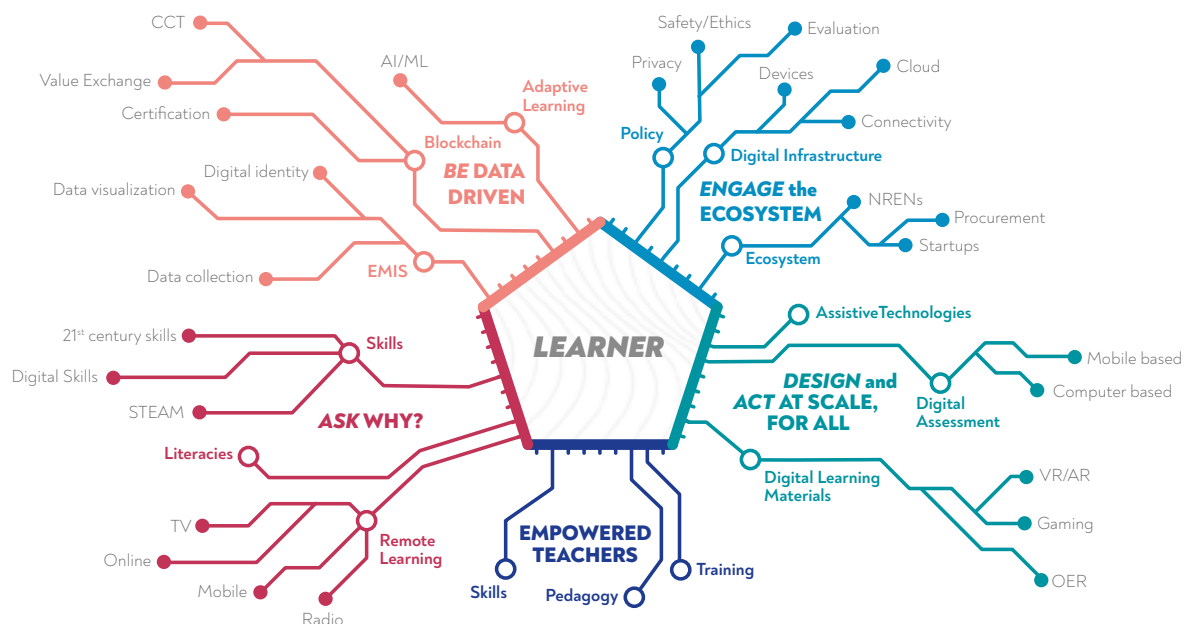


key to which is the “whole-of-government approach” to ensure a holistic and joined-up approach (e.g., connectivity for schools). This is also key to facilitating the inclusion of children with disabilities in education systems and the provision of the right policies and resources. The roadmap highlights focusing on what needs to change to improve learning outcomes as well as the knowledge and skills students require. Learning should be personalized and based on the needs of the student—a point that has consistently been made by proponents of inclusive education. EdTech can enable this, but it must be for all learners and not widen inequalities. Design must be for inclusion and engage the end-user (the learner) to facilitate the rapid scaling of educational innovations at classroom and

systems levels. Learning must be provided through a range of media, including radio, television, mobile, and online. Both teachers and learners must learn not just how to use technology, but how digital pedagogies can enhance learning.

Crucial, especially from an inclusion perspective, is the need for more, not less, human engagement. Teachers have a key role to play as users of technology to enable learning. Ministries must be open to learning and be flexible to new approaches and systems and evaluate their impacts. The roadmap also talks about sharing data and avoiding technology and vendor “lock-in” (Hawkins et al. 2021, 23). This is crucial in the rapidly changing AT and EdTech worlds.

**FIGURE 3: A diagram illustrating the World Bank’s approach of the connected learner**



Source: Hawkins et al. 2021, 11.

**NOTE:** AI/ML = artificial intelligence/machine learning; CCT = conditional cash transfer; EMIS = Education Management Information System; NRENs = national research and education networks; OER = open educational resources; STEAM = science, technology, engineering, arts, and mathematics; VR/AR = virtual reality/augmented reality.

## what is the evidence of efficacy?

Debates are ongoing around how the impact of EdTech has been measured with much of the emphasis on the inputs of EdTech (e.g., number of computers provided to a school) and outputs (e.g., number of teachers trained to use technology), rather than on outcomes, such as improved learning outcomes because of using technology (Muyoya, Brugha, and Hollow 2016, 6).

These measures are already contested in debates about the effectiveness of inclusive education, as measurement of learning outcomes tends to be narrowly focused on literacy and numeracy scores, rather than more “citizenship-focused” measures, such as participation and inclusion.

Even in higher-income countries (mainly in the global north), there is a lack of data on the different ways in which learning technologies are used to support students with disabilities, as well as a lack of recommendations for good practice (Hersh and Mouroutsou 2019). In their review of 15 higher-income countries,<sup>4</sup> 12 European countries, and Australia and South Korea, Hersh and Mouroutsou (2019) note that greater availability of devices and technologies reduces costs, but brings with it other challenges, such as language availability, with majority languages (particularly English) dominating. They note that the “bring-your-own device” approach was gaining

traction across a number of countries, whereby the learner brings their own device to their learning institution. While this has the advantage that the learner is already familiar with the device, and has all they need already installed, it obviates the need for schools or educational institutions to supply a range of ICT and EdTech devices. This approach transfers the costs from the institution to the learner, which could be substantial. They surmise that students from disadvantaged backgrounds will be even more disadvantaged unless they have additional support. Funding for learners came from various (generally) public sources, including local education authorities and social services. There were also examples of funding by health insurers and rehabilitation funds. However, they note:

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*The fact that national health services, health insurance, and/or social services, rather than education ministries, funded learning (or employment support) technologies in several countries may indicate that disabled people are frequently treated as patients rather than citizens requiring support to overcome barriers. (Hersh and Mouroutsou 2019, 3340)*

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<sup>4</sup> Australia, Estonia, Finland, Germany, Greece, Indonesia, Ireland, Italy, Korea, Lithuania, Poland, Serbia, Slovakia, Slovenia, and the United Kingdom.

**Across the 15 countries included in their study, Hersh and Mouroutsou (2019) conclude there is better provision overall of learning technologies for persons with sensory impairments, particularly visual impairments, though they did not find any specific reason as to why this might be so.**

Similar findings emerged from the systematic review by Lynch, Singal, and Francis (2021), which notes that the majority of studies were conducted in special schools and including learners with sensory impairments rather than learning disabilities. The review also notes the language limitations of most devices (Lynch, Singal, and Francis 2021, 10). Little evidence was found of parents being involved in deciding which technology they should use and how it should be approached, or even being consulted in terms of what role they should play. The authors also found a focus on the development of the technology per se, rather than aligning it to curriculum goals or how the technology can help teachers to support more inclusive access. They make a series of recommendations, divided across research and policy. One of them is to conduct a four-stage consultation to create a priority list of AT and a support training package.

No single established list of accessible and assistive education-focused technology is available in LMICs, though some are listed in Banes et al. (2020). WHO and the United Nations Children's Fund (UNICEF) have developed a range of [resources](#) to support inclusion, which complements the [WHO's APL](#).<sup>5</sup>

A recent evidence review by a panel of global experts, co-hosted by the UK Foreign, Commonwealth, and Development Office and the World Bank, identified what it considered to be "smart buys" for education ministries in LMICs (Global Education Evidence Advisory Panel 2020). The panel evaluated the evidence base for cost-effectiveness and categorized them into five levels from "great buys" through to "bad buys."<sup>6</sup> EdTech was mentioned as a good buy, but with a very specific caveat that educators used "software that adapts to the learning level of the child (where hardware is already in schools)" (Global Education Evidence Advisory Panel, 2020, 14). Of note, the only best buy was giving information on the benefits, costs, and quality of education that is contextually relevant, and crucially, can be acted on by parents, teachers, community members, and others.

According to the panel, where computers are already in use, using software that

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5 WHO's Priority Assistive Products List (APL) aspires to follow in the footsteps of its Model List of Essential Medicines, which creates awareness among the public, mobilizes resources and stimulates competition. The APL is similarly intended to be a catalyst in promoting access to assistive technology. It is not a restrictive list but aims to provide each member state with a model from which to develop a national priority assistive products list. Like WHO's Model List of Essential Medicines, the APL also provides guidance for procurement and reimbursement policies, including insurance coverage. The list includes hearing aids, wheelchairs, communication aids, spectacles, artificial limbs, pill organizers, memory aids, and other essential items for many older people and people with disabilities to be able to live a healthy, productive, and dignified life.

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6 Most of the evidence gathered came from high-income countries. Though evidence is slim, the panel believes the current explosion of innovation will strengthen the evidence base (Global Education Evidence Advisory Panel 2020, 14).

targets learning to the level of the individual child can be highly cost-effective, as evidence suggests from countries including India and Uruguay. Moreover, the benefits continue out of school. There is some evidence from Uruguay that they had the highest impact on the most disadvantaged learners (Global Education Evidence Advisory Panel 2020, 14). Computers can aid teaching at the right level when other factors are in place, including electricity, internet connection, hardware availability, as well as teacher training, and appropriate software is used. Merely investing in inputs, such as computers or textbooks, that demonstrate tangible evidence of investment, without improving how they are used or for whom, will not result in improved learning (Global Education Evidence Advisory Panel, 2020, 18). Therefore, while computers and other EdTech are also an input, the panel judged them to be a best buy as long as they are accompanied by other contextually relevant and considered measures, including personalized adaptive software and teachers trained on how to use the software. The panel also note that it can be more cost-effective to improve learning using available technology, such as mobile phones (Global Education Evidence Advisory Panel 2020, 19).

Finally, as is well established, little evidence was found about what works to improve access to education or learning for children with disabilities, and what little there is, is often small scale and therefore difficult to evaluate its impact (Global Education Evidence Advisory Panel 2020, 23). This situation and limited data about EdTech cost in the first place raise a number of questions, including whether EdTech is cost-effective as an investment in the long term, as well as raising questions about obsolescence and upgrading.

## impact of the COVID-19 pandemic

The impact of the ongoing coronavirus pandemic has been unprecedented and has impacted all sectors of society.

According to UNESCO, at least 1.5 billion students and their families have been significantly affected by school closures as a result of the pandemic (UNESCO 2020). To address the education gap, governments around the world have responded by switching to remote or distance learning through the use of TV, radio, or the internet to ensure that students have a way to continue their studies.

However, it is also unclear how many students with disabilities are receiving educational support largely due to a lack of disaggregated data and information, but the disproportionate effect on already marginalized and excluded learners has been well documented (Barron et al. 2021; UNICEF 2019). Moreover, these figures are largely focused on learners who were already in school. Many children with disabilities are not regularly attending school or have never been to school, though exact numbers are difficult to obtain due to lack of data or reporting (Global Partnership for Education 2019).

A global learning crisis was occurring before COVID-19 as documented in the 2018 *World Development Report* (World Bank 2018b). For children with disabilities, the learning crisis existed long before COVID. The report *Every Learner Matters* argues that for children with disabilities, the learning crisis is two-fold—issues relate to education access and equity as well as



quality and learning (World Bank 2019). The pandemic offers an opportunity to change these systems for the better.

This last point highlights both the critical role teachers play—and one that can be supported, but not replaced, by technology—as well as the need for them to “teach to the right level.” This will require skills and tools that now are limited, especially in LMICs:

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*Understanding which teacher behaviors and practices most closely map to better student learning outcomes, and how to measure those behaviors and practices, are important steps to designing better policies and programs for recruiting and training teachers. (Filmer, Molina, and Wane 2020, 31)*

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A recent report published by the Education Development Trust reviewed the steps being taken by countries to ensure continuity of education under COVID-19, particularly for the most disadvantaged students (McAleavy et al. 2020). Overall, it paints a bleak picture, especially in LMICs where little attention has been paid to the needs of students with special educational needs and disabilities. It highlights the potential for this already marginalized group to be further disadvantaged by school closures (McAleavy et al. 2020, 2). Significant gaps in current provision are identified, in particular a generalized failure to monitor the interventions that were put in place to address school closures. The report notes that while many of these interventions were technology-based, they were not on their own enough of a guarantee of educational continuity and good outcomes. They

also rely on alignment with the curriculum and quality of teaching (McAleavy et al. 2020, 15).

Little research is available that identifies the most effective remote or distant learning approaches that support children with disabilities and address their education needs. The IEI's report, *Pivoting to Inclusion: Leveraging Lessons from the COVID-19 Pandemic*, acknowledged the emerging education, social needs, barriers, and issues experienced by learners with disabilities (World Bank 2020a).

Further, data from the COVID-19 School Closure Survey highlighted the challenges in remote learning for learners with disabilities. Inequitable access to devices as well as internet availability and data packages and limited to no access to assistive devices or accessible learning materials were reported by parents (World Bank 2020a). The survey found that 1 in 4 parents reported a lack of internet access and data, 1 in 10 parents pointed to lack of power and electricity as a barrier, and 23 percent reported not having available the device their child needed (World Bank 2020a). In addition, data from the survey also showed that access to a device does not always translate to access for the learners with disabilities. For example, while more than 60 percent of parents had access to a TV, less than 20 percent believed it was helpful in remote learning purposes for their child. In addition, learners with hearing and visual impairments were particularly excluded from any lessons broadcast on the TV or radio.

The follow-up report published in 2021 by the World Bank gives key examples of where a twin-track approach ensures the inclusive design of mainstream education programs combined with the development

of targeted support to address the specific needs of children with disabilities (World Bank 2021). Moreover, it also highlights the potential negative effects that technology can have if not appropriate for learners with disabilities (e.g., excessive screen time for learners with sensory issues) and highlights promising practices, including non-tech or low-tech approaches.

Even before the COVID-19 pandemic, remote or distance learners with disabilities experienced many barriers to education, from physical access, stigma and discrimination, lack of support through to lack of trained personnel and equipment (UNICEF 2019). Recommendations are in place to address these issues, ranging from legislation and policy through to improving education assessment and accommodations, modifying curricula and teaching practices, implementing competency-based learning, developing individualized education programs, and supporting teachers, family, and caregivers. However, there is no consensus on one systematized approach on using ICT in education in LMICs (Coflan and Kaye 2020). The COVID-19 pandemic offers an opportunity to redress this gap, but the growing evidence on the impact of COVID-19 on learners with disabilities does not indicate this is the case. The World Bank has produced a series of Knowledge Packs, including on EduTV, which details the benefits of television-based learning for a range of students, but it does not specially address learners with disabilities. Furthermore, both a Guidance Note on how to strengthen disability inclusion in education (Saavadra, Alasuutari, and D'Angelo 2021) and a more comprehensive Inclusive Education Resource Guide (Alasuutari et al. 2020) have been published to support country offices in developing and carrying out different activities (e.g., data collection and engagement with stakeholders in disabilities on planning and implementation).

Since May 2020, the Organisation for Economic Co-operation and Development, UNESCO, UNICEF, and the World Bank have undertaken three rounds of a joint Survey of National Education Responses to COVID-19. The first report noted that 56 percent of responding governments reported taking measures to provide specific support to students with disabilities during school closures (UNESCO, UNICEF, and the World Bank 2020, 24). However, responses to the third round of data collection show that less than one-third of schools in LMICs reported that all students had returned, increasing the likelihood of dropouts, and only one in four countries is providing incentives, such as cash, food, transport, or fee waivers, to help girls or children from disadvantaged families return to school. Student learning has been affected across the board, and while countries made efforts to address learning during school closures, there has been much less focus on enabling students to catch up on missed education. This means that already disadvantaged students, in particular students with disabilities, will be even less able to catch up with their peers without disabilities.

School closures have been substantial, amounting to the loss of an average of 79 instruction days in 2020. LMICs reported the most extended average duration of closures, placing them at the greatest risk of significant learning loss, especially for the most disadvantaged children. Moreover, the report goes on to note the following:

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*Only 25 percent of low-income countries compared to 96 percent of high-income countries reported regular or extra expenditures on digital learning. An additional allocation from government was*

*the most commonly cited source of additional funding across countries, particularly among high-income countries, as 86 percent of them reported. (UNESCO, UNICEF, and World Bank 2020, 8–9)*

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This clearly highlights the financial disadvantage for LMICs and the lack of funding to education globally. A policy brief published by the EdTech Hub, *Education during the COVID-19 Crisis: Opportunities and Constraints of Using EdTech in Low-Income Countries*, noted that technology alone would not solve the learning gaps and would require the efforts of teachers, parents, government officials, and many others (Raluca et al. 2021).

The United Nations Secretariat addressed these challenges in a note that recognizes the need for flexible and adaptive teaching approaches, adapted curricula or programs, and provision for alternative arrangements for exams and assessments (United Nations Secretariat 2021). Teachers need up-to-date contextually specific guidance and resources on how to deliver inclusive lessons, as well as for learners with specific impairments. They also support investing in the universal design of information and communications technologies for education and making them accessible to all. However, the Secretariat notes that in many countries, national initiatives to increase the availability of ICTs in education for persons with disabilities are lacking. Both ICT and disability actors work in isolation, creating problems of coordination and implementation of policies as procurement. Many of the devices required, such as augmentative and alternative communication (AAC) including voice output communication aids, are already included in the APL (WHO 2016).

The Secretariat also makes several recommendations about data and monitoring. They move away from merely collecting data on the numbers of learners with disabilities toward collecting more specific data about categories of disabilities that do not conflate impairments that require different interventions (e.g., deaf and hard of hearing learners), which make the data less useful for policy and program development. However, improvements in collecting disability disaggregated data can be linked to monitoring progress through an Education Management Information System (EMIS) or the development of indicators that track educational performance to accurately measure the progress of students with disabilities. Setting up a specific task force or group can facilitate this, and the committee also gave examples of where communities have been successfully engaged in monitoring educational outcomes for learners with disabilities (United Nations Secretariat 2021, 15). Some countries have established “disability helplines” as a recourse mechanism.

While most of these are not EdTech-specific solutions, they highlight the need for a robust, strengthened systematic approach to inclusion. More research and development of the most effective approaches for learners with disabilities is needed. As yet, it is unclear if the increased reliance on technology during the COVID-19 pandemic has led to reduced EdTech costs and improved outcomes overall. It also raises questions about procurement, availability, and obsolescence of some EdTech.

## what further evidence is needed to help close the gaps?

Much of the focus of research to date has been on the technology itself and how it may or may not support children's access to learning.

Much less focus has been on how children are assessed for these products or how technology is part of a plan to support inclusion more broadly.

Attention is growing in the disability-inclusive education sector on the need for improved assessment and identification mechanisms. Banes et al. (2020) recommend that children with disabilities should be identified using at a minimum the Washington Group questions; however, these questions are intended for population-level surveys and only give a proxy indicator of the prevalence of disability in population groups in general and specific functional limitations more specifically. More detailed questions for children are asked through the Washington Group/ UNICEF Module on Child Functioning and the UNICEF Multi-Indicator Cluster Survey. Still, in general, these are indicative of need and are useful only as a guide for planning resourcing needs. A more detailed individual assessment of a child's needs is necessary to appropriately identify and provide the learning supports required. It is difficult to extrapolate which children need assessment from population-level data.

A gap also exists between health-focused assessments and school-based assessments, with greater emphasis on the latter. This also influences budgeting decisions.

Funding based on school assessment is usually directed to the school rather than to the child, which may limit the child's ability to access learning supports outside of school.

Assessment of children for potential impairments is currently a gap in the skillset of community health workers (McCollum et al. 2016; Naidoo, Taylor, and Govender 2019.) Simple tools are being piloted (Hatch and Dombrowski 2019; Tekola et al. 2016), but most are impairment-specific, and there is still a need to develop more simple community-level assessment tools, possibly digital. Gaps in the literature are found around the roles and impact of allied professional staff (e.g., physiotherapists, occupational therapists, and speech and language therapists) within the education system.

The key role of teachers in inclusive education is already well established, but with less evidence about how they are delivering in practice. Teachers in most LMICs continue to face challenges of limited resources, over-crowded classrooms, rigid and inflexible curricula, as well as lack of competencies in using EdTech. Some countries, including Kenya, have begun to shift to a competency-based curriculum, which may redress some of these issues, but it is still too early to tell (Akala 2021). Evidence from the IEI's global survey on COVID-19 school closures further points to evidence that teachers felt unsupported during the pandemic, which has required a massive shift in service delivery. Less than one-third of teacher respondents believed they were receiving adequate support to continue helping their students with disabilities learn compared with their students without disabilities. More information and data are needed on the experience of teachers (World Bank 2020a).



A photograph of two children, a boy and a girl, looking at a tablet together. The boy is on the left, wearing headphones, and the girl is on the right, pointing at the screen. They are both smiling and appear to be engaged in a learning activity. The background is slightly blurred, showing a classroom setting.

# 04

## global survey on technology for disability-inclusive education

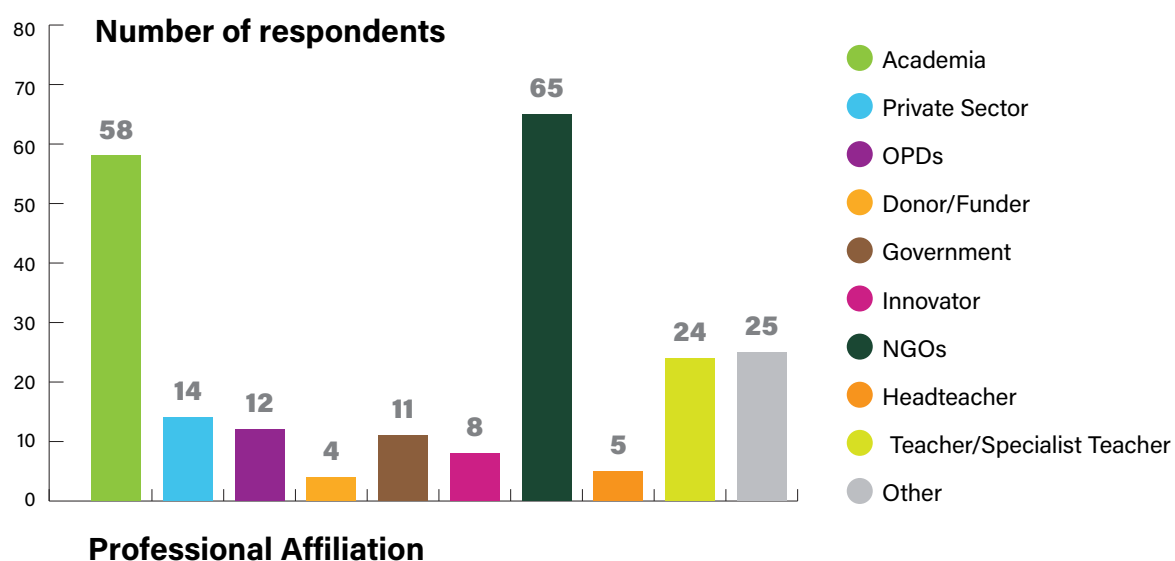
This chapter presents findings from the online survey undertaken for this study to ascertain the level of knowledge of various stakeholders about ICT for inclusive education; to identify what works and what does not work to improve learning outcomes of children with disabilities; and to identify what EdTech is available to support learning outcomes for children with disabilities across a range of settings. Findings here are based on responses from 226 participants.

Source: Shutterstock. Contributor Ann Gaysorn.

## participant characteristics

As shown in figure 4, the most common professional affiliation of respondents were NGOs (28.8 percent) and academia (25.7 percent), followed by health professionals and independent consultants (clustered under “other”) at 11.1 percent and teachers (10.6 percent).

**FIGURE 4: Distribution of survey respondents according to their professional profile**



Source: World Bank.

Most respondents were based in the African region (Rwanda 14.4 percent, Kenya 9.9 percent, and Uganda 4.5 percent), followed by the Americas (Mexico 7.2 percent, United States 5.4 percent, and Brazil 2.3 percent), Asia (Sri Lanka 4.5 percent, Bangladesh 4.1 percent, and India 3.2 percent), and Europe (United Kingdom 6.3 percent and Italy 2.3 percent).

Respondents' areas of expertise were primarily linked to education (total = 54.7 percent: mainstream 28 percent; special education 26.7 percent), or disability and accessibility (28.5 percent), with only 10.6 percent of respondents stating they had expertise in innovation and product development, and less than 2 percent reporting commercial experience.

## ICT for inclusive education

Almost 30 percent (n = 67 respondents) stated that they had no knowledge of any ICT or EdTech currently being used to support children with disabilities in the country in which they worked.

Of the 159 respondents who reported knowledge of ICT for inclusive education in their respective countries, 34.1 percent were able to cite at least one example, 27.1 percent presented two examples, 19 percent three examples, 12.3 percent four examples, and 7.5 percent five examples.

- The 358 examples provided by respondents included both low- and high-tech devices, mainstream and dedicated software, and a variety of educational platforms and repositories of resources. The technologies most commonly mentioned by participants were:
- Computers (laptops, desktops, personal computers)—32 mentions
- Text-to-speech technologies (screen readers, speech readers, Microsoft's JAWS)—28 mentions
- Braille writing equipment (slate and stylus, note takers, Perkins Braille, embossers)—27 mentions
- AAC technologies (communication boards and applications, GoTalk devices, Widgit symbol software)—25 mentions
- Accessible textbooks (accessible EPUB, Bookshare library, digital accessible information systems, OpenBook, Braille books)—22 mentions

These 358 examples were organized thematically to create a taxonomy of keywords representing the main types of ICT for inclusive education used in primary schools around the world (table 1). The taxonomy is organized across 12 broader categories, 35 subcategories, and over 80 individual keywords. Most categories of EdTech mentioned by respondents are already included in the APL, suggesting that adopting the APL would also facilitate countries in making these products more available to learners.<sup>7</sup>

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<sup>7</sup> Baner et al. (2020) also contains an extensive list of EdTech.

**TABLE 1: Taxonomy of ICT for inclusive education formulated based on the examples provided by respondents in the survey**

Main category	Sub-category
Tech for teaching	Interactive whiteboards
	Audio and video broadcasting technology
	Complete classroom toolkits
Braille reading and writing equipment	Reading equipment
	Writing equipment
Mainstream software and applications	Embedded accessibility features
	Social networks, instant messaging, and video conferencing
	Screen readers
Text to speech	Optical character recognition
	Victor readers
Personal electronic devices	Computers
	Mobile phones and tablets
	Voice recorders
	Accessible calculators
	Vibrating wrist watch
Platforms and applications for learning support	Multimodal digital learning platforms
	Educational applications
	Multi-language support software

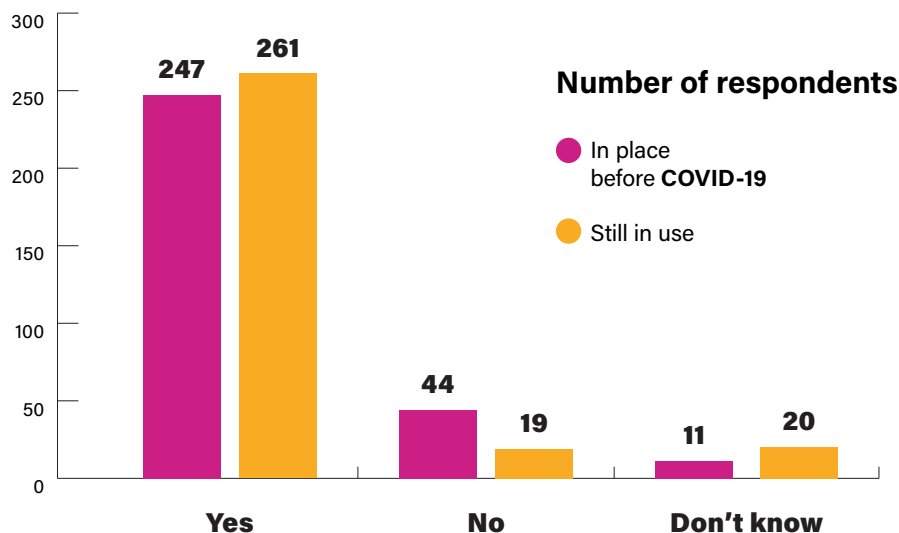
Source: World Bank.

The vast majority of these technologies (81.8 percent) were reportedly in place before the COVID-19 pandemic, whereas only 14.6 percent were developed or introduced solely after the start of the pandemic. As might be expected, almost all educational activities leveraging technologies (87 percent) are still in place in various countries around the world, with only 6.3 percent of them being reported as discontinued (see figure 5).

Some technologies mentioned by respondents were targeting learners with a specific type of functional impairment, whereas others were suitable for learners with a variety of impairments, including those with multiple disabilities. Some aim to be universally accessible to all users through smartphones and other mainstream technologies. Overall, 22 percent of technologies supported learners with communication impairments; 21 percent, learners with visual impairments; 18.1 percent, learners with intellectual or cognitive impairments; 15.3 percent, learners with hearing impairments; 12.9 percent, learners with physical impairments; and 9.8 percent, learners with psychosocial impairments.



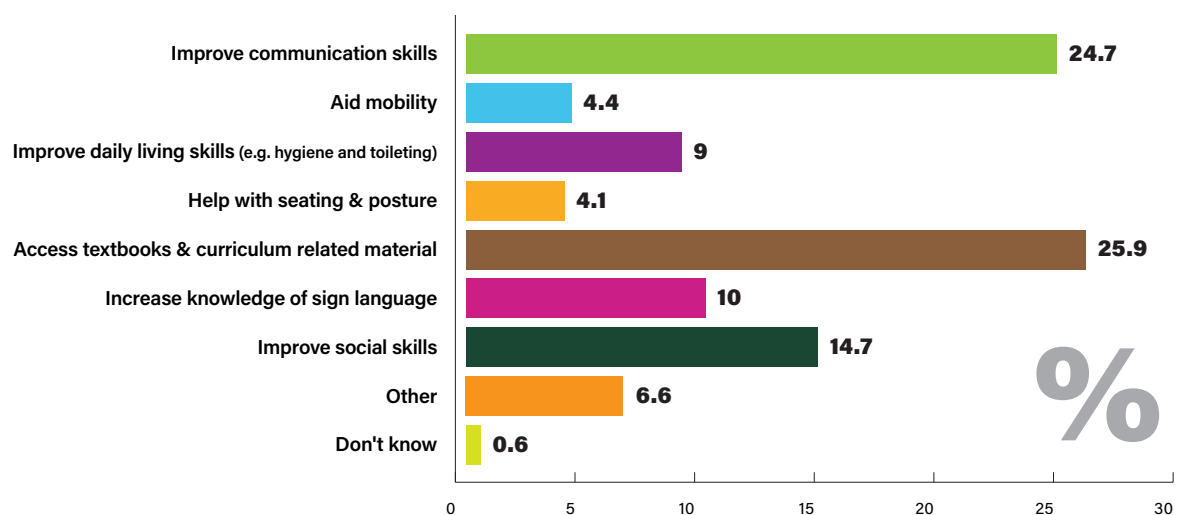
**FIGURE 5: Availability of ICT for inclusive education in relation to the COVID-19 pandemic**



Source: World Bank.

The purpose of different EdTech were varied and often one type of technology had more than one aim in its use, ranging from supporting the development of communication skills of the user to enabling access to textbooks and other material relevant to the curriculum or to aid mobility. Figure 6 summarizes the main functions attributed to the various EdTech cited by participants.

**FIGURE 6: Overview of purpose of different types of ICT for inclusive education**



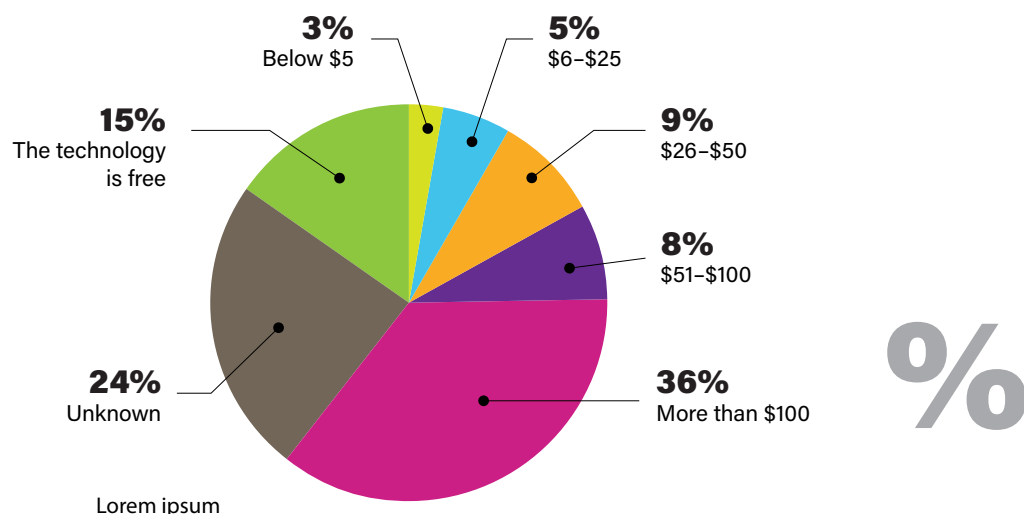
Source: World Bank.

Respondents reported that schools and families most commonly acquired these technologies through NGOs (25.2 percent) and government agencies (19.4 percent). However, direct acquisition through private sellers (18.1 percent), manufacturers (12.1 percent), or even self-production of devices by the school or the family (9.5 percent) were also reported as common ways to gain access to necessary technologies.

As expected, schools (23.2 percent), closely followed by OPDs (20 percent) and government agencies (17.6 percent), were mentioned as the most likely source of information, training, and support for users when learning how to use EdTech. Nonetheless, participants stated that about 1 in 5 users (19.6 percent) will need to learn how to use EdTech independently, with only the support of families or caregivers.

Cost was reported as a major barrier in access to both AT and EdTech. Respondents stated that more than one-third of the technologies they cited had a cost greater than \$100 (35.9 percent), with only 15.1 percent of technologies being available to schools or individuals free of charge (see figure 7).

**FIGURE 7: Overview of estimated price per unit of different types of ICT for inclusive education mentioned by survey's respondents**



Source: World Bank.

When EdTech or AT were acquired for learners, the most common way to assess if it appropriately matched the needs and capabilities of the user were usability tests (27.8 percent) and recorded observations on a chart or schedule (21.3 percent). Validated assessment tools were only used in 12.8 percent of cases, with graded progressions and accessibility

guidelines in 12.3 percent of cases each. Participants stated that for about 1 in 10 learners provided with EdTech or AT (10.9 percent), no tool or instrument was used to measure the appropriateness of the technology.

Of the technologies mentioned in the survey, 66 were developed directly by respondents or their organizations. Most of these organizations were based in the Global South, but 7 were from either Europe or the United States (see figure 8). Almost half of the organizations were NGOs or OPDs (44.1 percent), with other developers of EdTech and AT being based in university laboratories (17.6 percent) or hospitals and clinics (11.8 percent) and more in social enterprises (8.8 percent) or private companies (5.9 percent).

Over half of the respondents (55.6 percent) working on EdTech mentioned in the survey stated that these technologies were well past the piloting and testing stages and were being deployed in their own countries and, in some cases, in other countries as well.

**FIGURE 8: Distribution showing the country of origin of organizations who reported being engaged in the development of ICT for inclusive education**



Source: World Bank.



## summary of findings

**In summary, the findings from the global survey show that:**

- ✦ The level of awareness about the use of ICT and ICT for inclusive education is still relatively low among many practitioners.
- ✦ Although the COVID-19 pandemic brought increased attention to the use of technology in education, most of the EdTech that has been used to support the switch to remote education already existed.
- ✦ Participants were most familiar with mainstream technology, such as laptops, mobile phones, and messaging applications, or technology specific to a particular impairment type, such as Braille readers, hearing aids, or AAC technology. Rarer were mentions of more flexible tools to support learners with cognitive disabilities or specific devices linked to the study of a particular subject, such as modified calculators.
- ✦ A significant share of EdTech for learners with disabilities are still purchased by the family or school through private sellers or manufacturers without government mediation. In this context, both the cost of technology and low levels of awareness represent important barriers to access.



Source: "Young child listens on a mobile telephone" by Arne Hoel/World Bank under license CC BY-NC-ND 2.0.

# 05

## AI-powered research on academic and media articles

### results of media and academic searches

The purpose of this work was to understand the maturity of the research in the topic areas while also capturing trends in research and media interest in topics.

The searches conducted using MAG and the Event Registry identified 9,428 articles. Table 2 shows the breakdown of media topics and academic articles found by the searches carried out based on the categories of the taxonomy.

Source: Shutterstock.

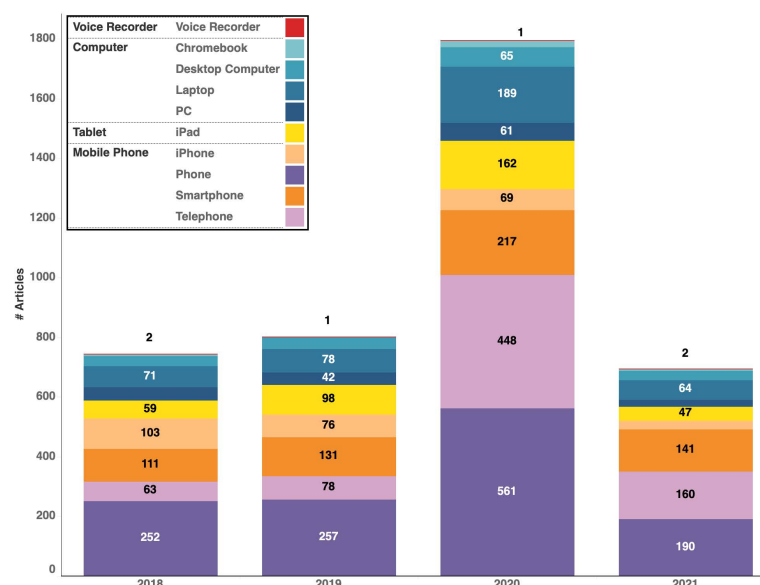
**TABLE 2: Total counts and ranked position of media topics and academic articles identified through the searchers on MAG and Event Registry**

Topic	Total media count (ranked position)	Total academic count (ranked position)
Augmentative and alternative communication	149 (1)	152 (3)
Assistive hearing and listening technology	531 (4)	110 (4)
Accessible textbooks	53 (10)	20 (10)
Technology for vision enhancement	425 (5)	66 (6)
Mobility technology	1018 (3)	355 (2)
Platforms and applications for learning support	69 (8)	32 (7)
Personal electronic devices	3091 (1)	980 (1)
Text-to-speech technology	256 (7)	151 (2)
Mainstream accessible software and applications	1065 (2)	88 (5)
Braille reading and writing equipment	40 (9)	11 (9)
Technology for teaching support	316 (6)	19 (8)
Technology for vision enhancement	425 (5)	66 (6)

Source: World Bank.

Personal electronic devices followed by mainstream accessible software and applications topped the media topic counts (see figure 9).

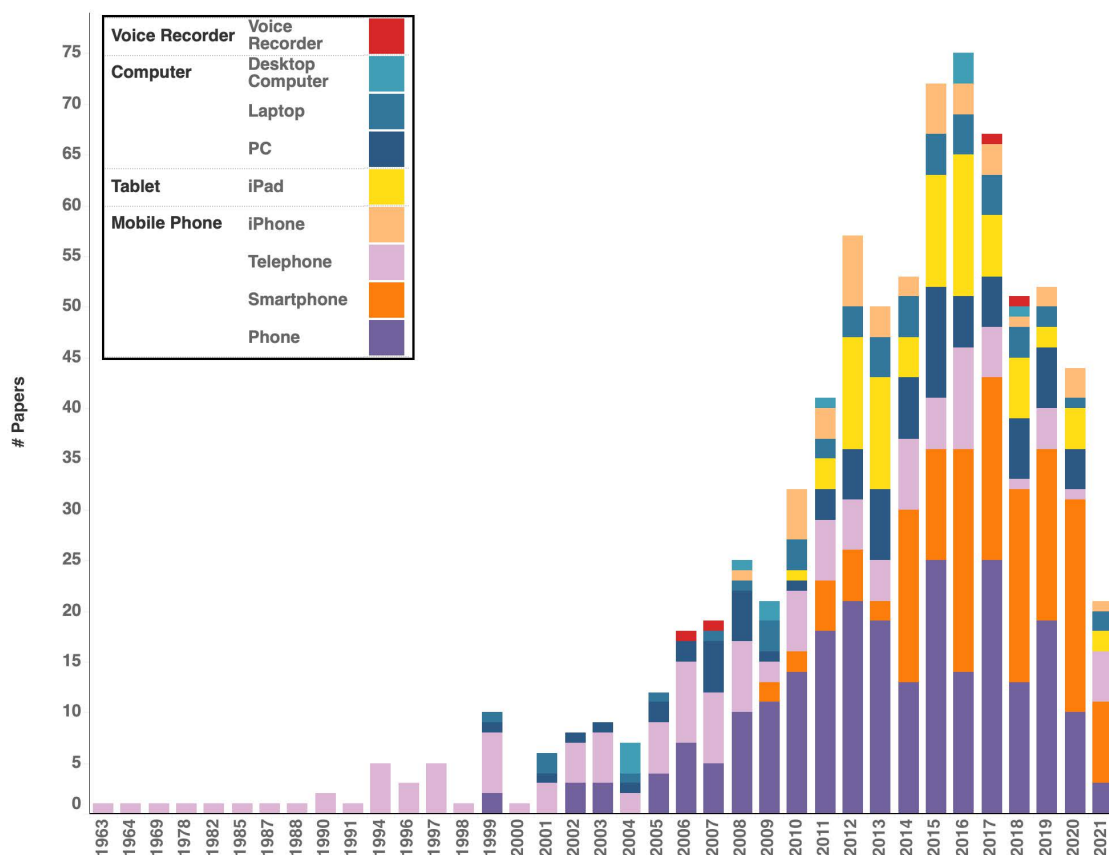
**FIGURE 9: Media articles on Event Registry focusing on personal electronic devices, 2018–August 2021**



Source: World Bank.

Personal electronic devices were also the most popular academic counted topic (see figure 10).

**FIGURE 10: Academic articles on MAG focusing on personal electronic devices, 1963–August 2021**



Source: World Bank.

The key findings from these trends are presented in table 3.

**TABLE 3: Main insights about media and academic trends toward the different types of EdTech categorized in the taxonomy based on the inspection of generated graphs**

Topic	Insights
Augmentative and alternative communication	<ul style="list-style-type: none"> <li>Academic interest toward the topic has steadily increased over the years and it is almost exclusively focused on digital AAC rather than physical communication boards.</li> </ul>
Assistive hearing and listening technology	<ul style="list-style-type: none"> <li>There were only 1-3 academic articles per year in this topic.</li> <li>The number of media articles was significantly higher with headphone interest peaking in 2020.</li> </ul>



Topic	Insights
Accessible textbooks	<ul style="list-style-type: none"> <li>Consistently low number of academic articles per year on the topic.</li> <li>Media interest increased steadily over the years with a shift from Braille books toward digital accessible books.</li> </ul>
Mobility technology	<ul style="list-style-type: none"> <li>Over 95% of academic articles and media topics focused on wheelchairs, compared with less than 5% on white canes.</li> <li>Media interest in wheelchairs has increased each year.</li> <li>Since 2005 there has been a marked increase in wheelchair re-research which may relate to new topics, such as smart wheelchairs and novel manufacturing possibilities.</li> </ul>
Platforms and applications for learning support	<ul style="list-style-type: none"> <li>Media interest in translation software peaked in 2018 with 62 topics. Last year, however, Google Classroom was the highest with 24 topics, possibly due to COVID-19 driven acceleration of use.</li> <li>Educational research peaked with 5 articles in 2014 within the academic database. It is possible a peak relating to COVID-19 could emerge this year given the time-lag for academic publications.</li> </ul>
Personal electronic devices	<ul style="list-style-type: none"> <li>Academic interest on the use of personal electronic devices peaked in 2016, but the media covered it a lot more in 2020 (possibly an artifact of COVID-19).</li> <li>Interest around the use of laptops, desktops, and even iPads has been declining, whereas interest in phones, smartphones, and telephones remains more consistent.</li> <li>Little academic interest has been seen around basic telephones since 2016, but more in the media.</li> </ul>
Text-to-speech technology	<ul style="list-style-type: none"> <li>Within assistive technology, there is limited research across the known EdTech platforms identified in the EdTech taxonomy.</li> <li>Mainstream technologies, such as Google Euphonia, will come online this year, which could transform the market, although this will only initially be in English.</li> <li>Media interest is healthier with over 20 topics across NonVisual Desktop Access and Fusion each year.</li> </ul>
Mainstream accessible software and applications	<ul style="list-style-type: none"> <li>Media interest in this topic surged during 2020, driven by a spike in Zoom-related topics.</li> </ul>
Braille reading and writing equipment	<ul style="list-style-type: none"> <li>Volume of articles and papers on Braille reading and writing equipment versus personal electronic devices is hugely different.</li> <li>Academic papers are almost exclusively on refreshable Braille displays.</li> <li>Media interest toward traditional Braille reading and writing equipment almost disappears in 2021.</li> <li>Orbit's refreshable Braille reader appears in the media in 2021.</li> </ul>

Topic	Insights
Technology for teaching support	<ul style="list-style-type: none"> <li>• YouTube dominates media topics with a peak of 144 topics last year, demonstrating the platform's increasing popularity.</li> <li>• Very limited academic interest in this space within the topic of assistive technology.</li> </ul>
Technology for vision enhancement	<ul style="list-style-type: none"> <li>• Media articles are nearly all regarding glasses, averaging over 100 articles per year and with increasing interest. Last year saw the highest number (12) of topics mentioning ZoomText.</li> <li>• Academic articles follow a similar trend with the majority of articles focused on glasses, although absolute numbers are an order magnitude smaller with less than 10 articles on average across the whole topic.</li> </ul>

**Note:** Digital AAC are high-tech standalone devices or software applications that can be installed on personal computing devices that support communication by producing a voice output in response to the input of the user. Communication boards are simple low-tech devices that display a set of pictograms that the person can point at to convey simple messages.

## technology hype and academic articles

When reading academic trends, it is important to note there will be waves of papers, provided there are sufficient numbers.

The first wave occurs when a new technology emerges. These papers all seek to prove the basic science and ensure it can reliably work in a range of scenarios. During this time, small-scale user studies will occur. Larger-scale studies can infer user needs from big data sets. Once the technology is proven and some basic design principles and applications exist, interest dips as people move onto the next big topic. A second wave emerges when the technology is rolled out and used in daily life. This stage is about capturing benefits, understanding use, and developing advances across scenarios of use. The findings from the AI-powered scraping study showed insufficient fundamental research on the use of ICT for inclusive education to advance the state of the art.

At the same time, research is developing in the areas of mainstream technology, such as personal electronic devices. EdTech like any other sector will have technologies that follow the Gartner Hype Cycle. The cycle has five phases. It starts with a "Technology Trigger" that leads to a "Peak of Inflated Expectations," followed shortly by a "Trough of Disillusionment," followed by a "Slope of Enlightenment," and then a "Plateau of Productivity."<sup>8</sup> When allowed

<sup>8</sup> The definition of Hype Cycle is available on the Gartner website at <https://www.gartner.com/en/information-technology/glossary/hype-cycle>.

by enough academic papers, this research looked for indications for each stage because they can help inform approaches to investment in ICT for inclusive education. In table 4, the Gartner Hype Cycle phases can be seen, along with suggested investment implications in relation to the Global Disability Innovation Hub (see appendix C).

**TABLE 4: Gartner Hype Cycle phases mapped to elements of the GDI Hub inclusive investment lens approach**

Gartner Hype Cycle Phase	Possible investment implications
Technology trigger	Raise awareness of inclusive design benefits and develop case studies of disability inclusion specific applications.
Peak of inflated expectations	Assess the most likely applications to succeed and assess market options for disability-inclusive avenues.
Trough of disillusionment	Build evidence of market and product-need fit.
Slope of enlightenment	Invest in evidence building at scale.
Plateau of productivity	Continually assess for new options for disability-inclusive data and evidence strengthening and diversification of technology applications.

**Source:** World Bank.

**Note:** GDI Hub = Global Disability Innovation Hub.

Hype curves are created for topics each year by Gartner. For example, the Artificial Intelligence Hype Curve contains technologies, such as natural language processing, chatbots, machine learning, and computer vision (Gartner 2014). However, these terms did not make it into the findings despite their usefulness for developing new intelligent EdTech. This means that within a topic, such as Technology for Vision enhancement, this research did not find mention of computer vision. This points to a gap and disconnect between core technology trends and trends on ICT use for inclusive education. Based on this media scraping study, there appears to be a disconnect between core technology trends. This gap could be bridged through a better understanding of inclusion with EdTech communities and a better understanding of emerging technology trends and their possibilities in the inclusive-education communities.

# 06

## country case studies on using ICT for inclusive education

This chapter starts with a brief overview of the inclusive-education context and COVID-19 response of the five countries, before turning to findings from interviews undertaken in each of them.

The country-level overviews are not intended to be exhaustive, but rather to give a snapshot of the education ecosystem and the available resources against which the interviews were undertaken. The findings from the interviews are grouped under each of the 6 P's to illustrate the situation across the entire education ecosystem. Under each "P," the common themes that emerged across the five countries are highlighted, followed by country-specific insights.

Source: Inclusive Education Initiative, World Bank.



## country context overview

### Bangladesh

**In Bangladesh, disability inclusion is on the agenda for both the Ministry of Education and the Ministry of Primary and Mass Education.** However, children with disabilities fall under the purview of the Ministry of Social Welfare, resulting in fragmented responsibilities or gaps in providing education services to children with disabilities. This results in several challenges, including delays in provision of teaching materials or assistive devices (Siddik and Kawai 2018).

Since 2008, Bangladesh has been pursuing “[Digital Bangladesh](#)” a program to increase access to digital public services, leading to a substantial increase in online learning opportunities since 2010. Examples include a student platform, Konnect, which provides learners with online learning content and live classes. The government’s e-learning platform [MuktoPaath](#), which mostly hosts online courses and virtual classes at the tertiary level, has more than 690,000 subscribers (Sarwar, Hossain, and Kaye 2020). However, challenges remain, including infrastructural barriers, limited electricity supply, and resourcing (Mou 2016). The costs make it difficult to allocate sufficient funds for ICT equipment, and most rural schools are limited in the number of devices, such as computers, multimedia projectors, or printers, they can access (Mou 2016). Bangladesh faces additional challenges as it hosts around 1 million Rohingya refugees. Education programs for refugee children with disabilities are currently limited (Thompson 2020; UNICEF 2020).

The government of Bangladesh has mobilized a stimulus package to support COVID-19 affected industries and communities, but it is not yet clear how education services will be strengthened and supported, let alone for children with disabilities (Rohwerder et al. 2021). However, the government was able to build on the foundations laid by its [English in Action](#) program. It uses mobile phones, print-materials, television, and peer-to-peer learning to help 25 million Bangladeshis improve their English as a route into work and out of poverty. This program has influenced the emerging education continuity plan and the prioritization of television broadcasting within this plan. The plan has been developed with close collaboration between the Ministry of Primary and Mass Education, the Department of Secondary Education and Higher Education, and the ICT division of the government, a unit called [Access to Information \(a2i\)](#). a2i has established four technical working groups (radio, television, internet, and mobile phone), each with responsibility for planning the implementation of remote learning during and after COVID-19 (Ndaruhutse, Gibbs, and Fitzpatrick 2020). At this time, phone-based remote learning is not implemented at scale. The government has also developed the Education Hub, a digital platform to host educational resources for schools and parents, alongside a communication strategy to help parents to engage with their children’s learning and disseminate messages about online safety to parents and children. Within refugee camps at Cox’s Bazaar, UNICEF provides print-based materials to support parents teaching their children (Ndaruhutse, Gibbs, and Fitzpatrick 2020).

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## Ethiopia

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**Literature focusing on Ethiopia shows a very significant disparity of access to education and EdTech between children depending on location, disability type, and gender.**

Children from Afar, Benis-hanguel-Gumuz, Gambella, and Somali (often called emerging regions) have the lowest level of enrollment compared with other regions (particularly Amhara; Oromia; Southern Nations, Nationalities, and People's Region; and Tigray). In the Gambella region, for example, no children with hearing or visual impairment were found attending school (Tefera, Admas, and Mulatie 2015, 57). And girls with disabilities from emerging regions (those with lower socioeconomic status) and/or rural families are generally among the most marginalized groups in Ethiopia.

During school closures, less than 10 percent of learners could access education remotely. Even with the gradual reopening of schools in October 2020, it is estimated that only 50–60 percent of learners have resumed classes (OCHA 2021). Prior to the pandemic, areas where free school meals were offered had higher rates of enrollment and retention. It is also unclear how many of the children who did receive lessons during the pandemic are children with disabilities. Tiruneh et al. (2021) noted that during and after the COVID-related school closures in Ethiopia, children with disabilities did not have adequate formal learning opportunities due to the absence of specialized learning materials and personnel. They also lacked access to specialist services, such as physiotherapy or speech therapy, which would have been available at school. Significant concerns were raised about children's socio-emotional well-being, especially increased feelings of

loneliness and anxiety. Their parents voiced considerable challenges in meeting the educational and emotional needs of their children as well as continuing to engage with their livelihood activities (Tiruneh et al. 2021).

Initiatives are being developed in Ethiopia for children with disabilities. For example, [SENTIgray](#) is using solar-powered [MegaVoice](#) devices to give students who are blind access to textbooks and additional learning and reading materials (World Bank 2020a). Some high-tech options can accommodate children who use screen readers and require voice output, and there are options with sign language interpretation alongside the material presented on TV or by video clip. However, this is typically only available for children with access to such technology.

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## Kenya

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**The Ministry of Gender, Children, and Social Development is the focal point for disability issues in Kenya.** There are Disability Mainstreaming Committees in government ministries and departments (Rohwerder 2020). The National Special Needs Education Policy Framework (2009) underwent revision in 2018 as the "Sector Policy for Learners and Trainees with Disabilities" to ensure alignment with the CRPD on the principle of inclusive education (Rohwerder 2020). The new policy highlights that the financing of special education is a major challenge largely because, as with many other countries, no specific funding directly goes to children with disabilities in mainstream classes, though schools may get an additional subvention at the administrative level. Initiatives, such as the

Social Protection Investment Plan (SPIP), have complimented constitutional legal and policy commitments under the ministry's guidance in coordination with the Ministry of Education. The SPIP currently awaits Cabinet approval. It sets out an ambitious schedule for expanding social protection in Kenya, including specifically for persons with disabilities, such as a child disability benefit and a new disability benefit for adults with severe disabilities (Kabare 2018).

Kenya is currently ranked 14th in EdTech start-ups globally, attracting about \$10 million in venture capital funding. Still, only a few of them have scaled up regionally with low-cost solutions requiring minimal digital skills (GSMA 2020a). For instance, [eLimu](#) provides digitized curriculum content for upper primary students that integrates videos, games, and sound or music in an affordable mobile app. It grew from 500,000 users to 750,000 users during the pandemic (GSMA 2020a). In 2018, Airtel's Internet for Schools Program partnered with Computers for Schools Kenya and Longhorn Publishers to provide free access to internet services in 30 schools in Nyeri County as well as access to e-learning content from Longhorn Publishers (GSMA 2020a).

Inclusive education for learners with disabilities or displaced populations has been made possible by low-tech solutions adapted to their needs. For example, start-up eKitabu distributes accessible digital content in local languages in 13 African countries through Orbit Reader to help learners with visual impairments read.<sup>9</sup> It also launched Studio KSL (Kenyan Sign Language) to help the deaf community

access sign language instructional videos and visual storybooks (GSMA 2020a, 30). These low-tech initiatives are intended to be accessible offline at no cost to enable access to quality knowledge more equitable for learners with disabilities.

However, several large-scale EdTech options applied during the COVID-19 pandemic were less accessible to children with disabilities, especially for those with visual, hearing, and cognitive disabilities, including radio- and TV-based learning. More accessible initiatives, such as those provided by Airtel, eKitabu, eLima, and Eneza Education, have all launched low-cost or free education programs designed to be accessible to children with disabilities. However, for sustainable and impactful EdTech to be applied, further investment in identification of needs, awareness of options, training of teachers, access to resources, and increased investment in education is needed. While several EdTech initiatives have been piloted before and during the COVID-19 pandemic in Kenya, information is limited regarding the accessibility and outcomes of these interventions on children with disabilities.

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## Nepal

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**Nepal has a raft of policies and action plans around disability, including the National Policy and Plan of Action on Disability (2006).** It stated that a policy would be adopted to provide free education on all levels to people with disabilities, and residential facilities would be developed in each district for such children. Nepal ratified the CRPD in 2010, and disability

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9 For more information, visit the webpage "Accessible digital content for quality education" on the eKitabu website at <https://www.ekitabu.com/content/>.

rights are guaranteed by the 2015 Constitution and the Rights of Persons with Disabilities Act (2017), among others. The Ministry of Women, Children, and Senior Citizens and a National Disability Direction Committee are responsible at the national level. In contrast, at the village and municipality level, there should be disability coordination committees (Rohwerder 2021). Within the education system, a disability assessment officer or resource person is supposed to receive basic training in disability awareness and identify children with disabilities in coordination with the local office of women, children, and social welfare at the municipality level. As this is a school-based service, it is only accessible to those attending school.

The government has made significant efforts to include children with disabilities in the education system, including policies to promote inclusion such as the 2017 Inclusive Education Policy for Persons with Disabilities and the School Sector Development Plan 2016–2023. However, despite these efforts, many children continue to be left out of education, especially children with disabilities, including girls with disabilities and those living in remote rural areas (Eide et al. 2019). Some pre- and in-service teacher training on inclusive education and disability is provided by the government and NGOs along with specific training courses on special education; however, there is very limited training in ICT skills at the primary or secondary school level (Dhakal and Pant 2016).

Nepal faced numerous development challenges even before the COVID-19 pandemic, particularly for adults and children with disabilities. The *COVID-19 Education Cluster Contingency Plan, 2020*, developed by the government and United Nations agencies,

includes tailored approaches based on need of, for example, children living with disabilities and other children identified with pre-existing vulnerabilities (Nepal Education Cluster 2020, 3). Digital and remote teaching materials are identified as means to do this. However, the UNICEF Child and Family Tracker shows that only 5 percent of children in the poorest households in Nepal have access to and use distance learning. The poorer the household, the less likely it is that children can access or will use distance learning (New Spotlight Online 2020). Provision of a variety of home-based learning supports are all focused on children who were already in school.

There is a mushrooming of EdTech start-ups in Nepal, especially due to the pivot to remote learning during the pandemic and the proximity to India. For example, one website provides a list of EdTech start-ups in Nepal, most of which are education platforms for school management rather than education providers, and there is no specific mention of provision for learners with disabilities. Another is [OLE Nepal](#), which provides laptops and digital services to schools across Nepal. They also provide a digital library, with over 6,000 books available online. However, it is unclear how many of these are accessible.

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## Rwanda

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**As part of his vision to revitalize the country, President Paul Kagame has called for SMART classrooms, powered by solar and with access to the internet.** However, the rollout has been slow, and its alignment with a vision for teaching and learning is less clear (UNICEF 2018). The Rwanda Basic Education Bureau (REB) has set up an e-learning portal that hosts



a range of educational content, including interactive and animated content, videos, and e-books (Kimenyi, Chuang, and Taddese 2020). Rwanda also initiated a [One Laptop Per Child](#) program, but challenges related to lack of electricity and internet have surfaced throughout the implementation (Bizimungu 2018) as well as more recent plans to change laptop providers (Kimenyi, Chuang, and Taddese 2020).

[Mastercard Foundation's Centre for Innovative Teaching and Learning](#) is headquartered in Rwanda and aims to “drive the innovative use of technology to close gaps in access to education, building the evidence on effective and appropriate use of technology in education, and fostering a network of innovators and leaders to advance the use of educational technology in policy and practice across Africa.” Another tech-focused program funded by Mastercard Foundation in partnership with the REB, Ministry of Education, and University of Rwanda is the Teacher Training Program of the [African Institute for Mathematical Sci-ences](#). It is focused on building knowledge, skills, and behaviors when teaching mathematics and sciences using ICT (Kimenyi, Chuang, and Taddese 2020).

[Africa Knowledge Zone-Know Zone](#) is a locally produced TV series shown in Kenya, Rwanda, and Uganda. It aims to raise children's literacy and numeracy levels and is aligned with official primary school curriculum. The program supplements its educational TV content with two-way interaction with viewers through SMS (short text messages) and social media channels. There is some evidence of success, and data showed that in 2014, Know Zone

reached 3 million viewers, with children who watched Know Zone outperforming non-viewing children who owned a TV by 10 percent (Moss 2020). However, it is not clear what percentage of viewers who benefited from the series were children with disabilities.

Prior to the COVID-19 pandemic, learners with disabilities were apparently supported through classroom arrangements, assistive devices, and timetable settings to cater to their different needs (e.g., special needs education). During the COVID-19 crisis, the Ministry of Education has tested different ways to continue supporting learners with disabilities. For example, lessons broadcast on TV and through e-learning platforms have sign language interpretation (UNICEF Rwanda 2020), while learners with visual impairments are expected to access lessons delivered through radio programs. However, these approaches reach only a small number of learners with disabilities. For example, learners with visual disabilities complain about the lack of Braille-translated materials (Mbonyins-huti 2018). The government is struggling to reach more learners with disabilities, in part because of the quick transition to distance learning (Ngabonzima et al. 2020). Some have argued that the education of children with disabilities has stopped altogether, partly due to lack of access or parental support (Nyembo 2020). The government has decided that the school year will be repeated when schools resume, though some scholars have suggested that this may reduce learners' motivation to take part in distance learning, especially secondary students (Ngabonzima et al. 2020).

## insights from key informants

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### People

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#### Is EdTech truly inclusive of everyone?

Stakeholders from all countries mentioned several programs and initiatives that focused on the introduction of EdTech to improve learning of children in primary school. Unfortunately, many of the remote education strategies deployed, especially on a large scale, were not inclusive of learners with disabilities. Most stakeholders recognized that learners with disabilities were the hardest hit by the consequences of the pandemic due to the limited access they had to the remote learning opportunities that were implemented.

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*Most of children with disabilities come from impoverished family, and it was really hard for them to access internet during taking their online lessons and submitting their assignments. (Ethiopia P9, NGO)*

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For example, early results from a [Building Learning Foundations](#) assessment shows that learners with disabilities were less likely to have done any learning during school closures in Rwanda than children without disability (Education Development Trust 2020). This means many children with disabilities will need catch-up lessons, especially if they have never previously been to school. The difficulties encountered by learners in accessing remote education

were linked to a variety of factors, including unavailability of devices, such as laptops, mobile phones, televisions, and radios; no access to electricity or connectivity in the home; high cost of data for mobile internet; inability of teachers to provide adequate support in remote learning modes; unavailability of learning material; and inaccessibility of certain forms of remote learning for learners with particular types of impairment.

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*Children with disabilities are completely out of education system since the country got affected from the pandemic. All the schools are closed, and children have remained inside their own houses. They do not have access to technology. The government ran sessions through radios and televisions but these were not disability friendly. (Nepal P10, OPDs)*

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Even among learners with disabilities, significant differences were found in the ability to successfully access and leverage EdTech both before and during the COVID-19 pandemic based on the nature of the learners' impairment. In particular, children with cognitive impairments were consistently reported by interviewees to be systematically excluded from being able to access and benefit from EdTech and most remote learning opportunities. In addition, although to a lesser extent, stakeholders from relevant ministries, OPDs, NGOs and parents' groups reported that students with hearing and visual impairments also faced significant challenges in leveraging EdTech for learning.

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*COVID-19 negatively impacted students with disabilities. For example, students who rely on AT where not able to access them. Students with visual impairments were not able to access materials, and those with hearing impairments were not able to follow radio lessons. (Rwanda P17, Ministry of Gender and Family Promotion)*

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Interestingly, several stakeholders mentioned that EdTech presented less challenges for students with mobility impairments and that the switch to remote learning may have actually been beneficial, as it allowed them to avoid many of the environmental barriers linked to the need to physically access school.

### **Many stakeholders with diverse knowledge gaps**

The lack of training opportunities and support that are necessary for teachers to incorporate EdTech into their teaching in an accessible manner was highlighted by almost all interviewees as a key roadblock to implementing ICT for inclusive education in primary schools. Several stakeholders pointed out how training for digital fluency is rarely available to teachers. In mainstream and inclusive schools, many teachers often do not receive appropriate training on inclusive education for face-to-face classes. As a result, they have little knowledge on how to adapt the delivery of lessons to a set of learners with diverse abilities. They also are more likely to feel that EdTech and ATs are unnecessary or, worse, an additional

burden for which they are going to be held responsible, but for which they are unlikely to receive any support.

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*I found that most of the teachers even in resource schools have not been receiving any training for last 15 years. They received a short training when they started the job, but since then, they have not been given any such training as follow-up or refresher. This is even worse in the case of mainstream schools. Most of the teachers do not even know the concept of inclusive education let alone the use of technology. (Nepal P5, international NGO)*

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As a result of the prolonged school closure triggered by the COVID-19 pandemic, several government departments and organizations mentioned that they have released, or are planning to release, dedicated training for teachers on how to adapt to lessons for remote learning. However, none of the stakeholders interviewed mentioned that accessibility, AT support, and disability inclusion will be included in this training, which could lead to further widening of the ICT for inclusive-education gap.

The lack of opportunities for teachers to develop relevant skills combining inclusive education and ICT was also identified as a priority barrier that needs to be addressed by the panel of global experts involved in the Delphi consultation conducted as part of the study. The panel highlighted how a key consideration to be taken into account is that the teachers should not be “blamed” for their limited digital

literacy or insufficient knowledge of UDL, as these gaps occur as a result of lack of opportunities more than lack of will. Instead, teachers should be encouraged and empowered to leverage EdTech to make their teaching more effective and shown how inclusive approaches lead to better learning experiences for all students.

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*Because this area of ICT, we can say is a recent trend, and many teachers have a phobia of digital devices. And so we should increase reaching out to the teachers and then encourage them to learn more about ICT. We continue integrating training. Maybe ICT training will make sure that the teachers learn more about ICT. (Kenya P2, Ministry of Education)*

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Many interviewees also pointed out a need to better support a variety of stakeholders who have often very different needs. First of all, learners with disabilities themselves are rarely actively included in the development, selection, and implementation of EdTech at the primary school level. This can have significantly negative effects for children with disabilities, not only within primary school, but throughout their lifelong learning as they lack the required digital fluency to access and take advantage of potentially available learning opportunities.

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*The use of ATs in primary and secondary schools is not that much experienced in Ethiopia. Blind and visually impaired students do not*

*learn about ICT, and there are no teachers well trained in AT to teach blind and visually impaired students. Therefore, blind and visually impaired students grow up without familiarizing themselves to ATs unless they have experienced them by their individual efforts and exposures. (Ethiopia P4, Other, Inclusive Education Consultant)*

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Secondly, interviewees advocated for increased involvement of parents and caregivers who were seen as essential figures in successful educational journeys for children with disabilities, particularly in light of the switch to home-based remote learning during the COVID-19 pandemic. Stakeholders from NGOs and OPDs in Kenya reported that, as many children with disabilities attended residential special schools before the pandemic, parents had little experience in supporting them with their education at home.

Moreover, many caregivers had limited digital experience or were illiterate, impacting their ability to provide support to their children. For example, in Ethiopia, the COVID-19 education response plan is heavily weighted toward high-tech options. This includes online platforms, radio, and television, which will only be successful if they are implemented in tandem with support to parents and communities with limited access, particularly for the hardest-to-reach learners, including those with multiple disabilities. Similarly, for first-generation learners whose parents are illiterate, it is very difficult to support their children in any text-based work. Some materials delivered over the radio, television, or a mobile phone app can be used





Source: Shutterstock.

by parents who cannot read or write, since the information is not solely based on text (World Bank 2020a).

Stakeholders highlighted how developing training and mentoring resources that specifically target caregivers is incredibly important to ensure continuity of learning when students with disabilities are away from schools.

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*We need to prepare some awareness program and capacity development or training programs, or some initiatives for our parents or caregivers, so that they can be an important and integral part of this blended education. So yes, this is very much needed for blended education system. (Bangladesh P5, Prime Minister's Office)*

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Beyond parents, teachers, and learners, interviewees mentioned that other groups of stakeholders lack specific knowledge that could play a pivotal role in the

successful development and deployment of ICT for inclusive education for primary school learners. Many entrepreneurs, developers, and innovators working in the EdTech domain have little knowledge of disability. They refrain from engaging in the development of accessible platforms and technologies as they fear the excessive complications. On the other hand, many governments officials and employees working on the development of national policies for inclusive education, or the drafting of emergency education plans to mitigate the impact of school closures, lack technical knowledge related to both physical and digital EdTech, including advantages and disadvantages in terms of accessibility. This prevents them from being able to address the needs of diverse learners.

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*So, I may be an expert in building games, in designing games, but when you are working with kids, especially kids who are visually impaired, we need expertise. (Ethiopia P7, start-up innovator)*

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## **BANGLADESH**

As a result of the experiences and learnings from the COVID-19 pandemic, the a2I (previously Access to Information) program in Bangladesh, situated in the Prime Minister's Office, is pushing for a new blended approach to education driven by technology combining traditional and remote education. As part of this new vision, there is understanding of the need not only to raise awareness among both educators and technologists to increase opportunities for collaboration, but also to provide training and support to a variety of stakeholders (from teachers and learners to school principals and government officials) to enable successful implementation. However, relatively low awareness or attention is being given toward including learners with disabilities in this vision. OPDs and NGOs have argued that increased collaboration between relevant stakeholders working across different government departments and direct participation of OPDs and other relevant organizations could ensure that this program will lead to better inclusion of children with disabilities in the new educational landscape rather than increase the current divide.

## **ETHIOPIA**

The realization of the crucial role of parents and caregivers in education has led to the development of EdTech that specifically aims to offer advice to caregivers on how to support learners during remote schooling. A successful example is the platform called Parentsy developed by the Ethiopian start-up Accelerated. Parentsy leverages Telegram to deliver bit-size material in the form of flashcards, videos, audio clips, and texts that parents can use to support the learning of their children and promote educational engagement. The use of a platform that most parents were already familiar with combined with the multimodal nature of the material provided have made Parentsy hugely successful with the target audience.

## **KENYA**

Many children with hearing impairments and limited sign language abilities found themselves at home for most of the day, surrounded by family members without adequate knowledge of sign language themselves and often unable to communicate with them effectively. To support children in continuing to develop their language skills while out of school and promoting connection and communication with family members, the Nairobi-based start-up Lugha Ishara launched a series of video-based sign language classes for the whole family. They also organized a sign language Christmas recital and conducted individual lessons and group rehearsals using video conferencing and small in-person classes when it became possible with government guidance. The program was a huge success. Caregivers reported that the experience made children more confident and led to better communication and sign language skills in social settings.

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**NOTE:** Telegram is a free and open source, cross-platform, cloud-based instant messaging software, often compared with WhatsApp.

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## Pedagogy

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### Challenges and importance of assessment and evaluation

Assessment and evaluation emerged both as key challenges and crucial enablers to the success of EdTech in improving the learning of children with disabilities at the primary school level. At an individual level, assessment is essential to understand what the learning needs of children with disabilities are, and what kind of AT, EdTech, or other adaptations are necessary to better support them. For many children, these evaluations are expected to take place at the school level, but most teachers do not have sufficient competencies to conduct extensive assessments, and they lack the support of specialized professionals. Furthermore, for certain types of impairments, such as cognitive and learning difficulties, there is no agreed codified procedure for assessing learners' needs, nor guidance on how to support students or indication of what types of EdTech might be most beneficial.

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*A fundamental issue is that everything is saying "special needs." I mean, there are some specific schools for the visually challenged and the hearing challenged students but apart from that, literally everything is just one big group. And especially with no diagnostics in place, no learner gets screened for any learning disability or any other issues or anything. So it's all a matter of feeling and perceptions. (Ethiopia P10, start-up innovator)*

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Assessment is also key for children to receive financial resources that support their educational journey. In Nepal, for example, to receive government support (i.e., the cash allowance for children with disabilities), children have to be identified and assessed. According to government policy, municipalities are required to operate mobile camps in areas under their jurisdiction at least once a year to facilitate the identification of persons with disabilities. However, this is not always the case, which can make it difficult for children to be assessed and receive adequate support (Holmes et al. 2018).

During the consensus-building Delphi process, global experts also pointed out how the lack of appropriate assessment pathways represents one of the biggest challenges to implementing ICT for inclusive education in many countries. Moreover, they highlighted how the assessment should not just happen at the initial "matching" phase but needs to be a continuous process that tracks the impact of technology on learning outcomes and the educational experiences of children with disabilities. This gap is also borne out in the literature.

Many programs, especially at large scale, leverage the use of national examinations to monitor the change in children's learning.

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*We run regular tests to assess all the children [including children with disabilities]. Some parents are also afraid about the tests; they think if their children receive lower grades, they may not receive attention. Like during reading tests many students opt to be absent*

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*from the classes. And the reason is the parents do not bring them along. (Bangladesh P4, NGO)*

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However, exams are often not adapted to the needs of students with disabilities. They offer a narrow mechanism of assessment and are unsuitable to evaluate the impact of EdTech, particularly for students who have more significant cognitive impairment, as a government official notes.

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*We want to give fair examinations and assessment to every child. But we don't know about the challenges of students with disabilities in exams. Our priority now is to conduct a study that will look at the challenges students with disabilities face during examinations. (Rwanda P18, Ministry of Education)*

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Finally, assessment and evaluation are not only needed to track the progress of individual children, but also to monitor the impact of entire programs and make decisions about the use of EdTech for disability-inclusive education. Many government and NGOs run initiatives that are not properly evaluated. They rely on informal and unstructured feedback collected from teachers, families, or users targeted directly by providers, which produces data that are hard to compare and highly susceptible to bias. On the other hand, relying solely on quantitative large-scale evaluation might miss the complexity of the impact of EdTech on the overall education and well-being of children with

disabilities. Overall, successful strategies strived to incorporate both quantitative and qualitative feedback at both the general and granular level.

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*We do regular monitoring using different tools, such as the School Accessible Assessment Tool and School Environment Assessment Tool. We do training of the field staff, and they do the regular monitoring. We also assess whether the School Improvement Plan, learning materials, and pedagogy are inclusive enough to accommodate children with different disabilities. At the individual level, we assess children's engagement, participation, and learning. (Nepal P5, international NGO)*

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## **Developing inclusive and flexible curricula**

Another key pedagogical challenge to the implementation of ICT for inclusive education at the primary school level is linked to the lack of integration with existing curriculum. The issue is multifaceted, as it concerns both the lack of adaptation of curricula to the needs of children with disabilities and the poor integration of technology into the curriculum. This became especially relevant—and problematic—in the pivot to remote learning that took place in response to the pandemic. Most guidelines about how to deliver lessons, support students with disabilities, or conduct examinations became suddenly inadequate.



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*There was also a subcommittee established under the main committee to look into curriculum and to provide education online by choosing the main content that the students can learn while being at home using this educational technology like TV, radio, and virtual. So in that regard, we have been actively participating in the committees. (Ethiopia P5, Teachers Group)*

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**Some attempts to do this were made, for example, in Kenya.**

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*UNICEF in conjunction with the Ministry of Education and KICD [Kenya Institute of Curriculum Development] was working to come up with some ways that the current curriculum for learners could be adapted into formats that are accessible for learners with disabilities. (Kenya P3, OPD)*

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The importance of incorporating technology in the curriculum as well as in teaching practices was also highlighted by Piper et al. (2015) comparing three separate EdTech interventions in the Kenyan education system which were e-readers for pupils, tablets for teachers, and tablets for tutors at Teacher Advisory Centers. All three promoted positive learning outcomes in English and Kiswahili when compared with the control group. What was consistent among the interventions was that these were aligned to the national curriculum. It did conclude that,

in addition to teacher training to optimize integration of EdTech, the government must address ICT as an instrument of teaching (Piper et al. 2015).

Government bodies in charge of the design of curricula also pointed out how incorporating the degree of flexibility needed to address the learning needs of primary school children with disabilities as well as negotiating the different accessibility challenges introduced by different types of technology can be extremely difficult. It requires cross-sectional expertise that cannot be addressed solely by ministries of education, as an official from Nepal notes.

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*In regarding to providing education technology/ICT for children with disabilities, we have not been able to progress as required. We need different interventions to tailor to the various needs of the children according to their disabilities. For example, the interventions designed for children with visual impairments do not work for children with hearing impairments. Providing supports to the children with multiple disabilities requires different supports. It is really challenging to design different IT interventions to tailor to the needs of children with different disabilities. (Nepal P15, Ministry of Education)*

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Finally, for most primary school children with or without disabilities, learning cannot be confined solely to curriculum material. Arguably, some of the most important

aspects of education linked to social participation mediated by schools and communities are not necessarily included in the curricula and are therefore overlooked.

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*The education system does not address language acquisition [for deaf children], because it is not in the curriculum, but it is the bedrock of education and something that most deaf children will otherwise miss. (Kenya P1, start-up innovator)*

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### **BOX 3: Country-Level Experiences and Insights: Pedagogy**

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#### **KENYA**

To facilitate the screening and educational assessment of children with disabilities by teachers in schools or employees working for relevant government agencies, an international NGO operating in Kenya and other countries in East Africa is rolling out an assessment tool that leverages questionnaires from the UNICEF Child Functioning Module. The aim is to combine insights generated from connecting the data of more generic questions around functional difficulties in different domains with more specific questions linked to education to create individualized learning plans and recognizing potential needs for various ATs or accessible EdTech. As part of this pilot scheme, the same assessment tool will be used to provide continuous assessment and monitor the children's learning progress, evaluating the impact of interventions and EdTech use.

#### **RWANDA**

The centralized nature of the education system led to the creation of adapted curricula for children with disabilities and a dedicated program for teacher training colleges that incorporates inclusive education and AT. One example is the tech-focused program funded by the Mastercard Foundation in partnership with the Rwanda Education Board, Ministry of Education, and University of Rwanda. The Teacher Training Program of the [African Institute for Mathematical Science](#) is focused on building knowledge, skills, and behaviors when teaching mathematics and sciences using ICT (Kimenyi, Chuang, and Taddese 2020). However, Rwanda still lacks formal education pathways for assessing children with disabilities and monitoring their progress beyond the use of data from national examinations. Unfortunately, the section of REB in charge of planning and monitoring examinations reported several challenges in screening primary school students with disabilities and identifying their needs for ATs or adaptations during exams. Officials expressed the hope that ICT for inclusive education might help to streamline some of these processes, which are currently carried out on an individual basis and with little guidance on how to support students to perform at their best in their exams.

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## Policy

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### Need for detailed implementation plans

All five countries studied had signed and ratified the CRPD. Similarly, they all have policies that outlined visions for inclusive education at the primary school level and ICT use in education. However, disability, ICT, and inclusive education (usually still overlapping with special education) often were under the jurisdiction of different ministries of government leading to the creation of separate, and often misaligned, policies. Among stakeholders working in organizations outside government, the research also found limited awareness of the various relevant policies that might guide and support the selection, procurement, and delivery of ICT for inclusive education for primary school learners. Furthermore, stakeholders working on the ground generally felt that policies were a rather distant tool that had little connection with everyday practices in schools, communities, and homes.

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*I am not really aware. But even if those policies are there, I am not sure if they are being used, because if they were being used, then they will have trickled to the community level where we work. (Kenya P9, Parents Group)*

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Although policies concerning the procurement and use of EdTech and AT for inclusive education were present across the five countries, the biggest challenge was that

most of them were described as largely “aspirational” with very limited details concerning practical implementation plans that could be used to guide and coordinate the efforts of different parties involved.

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*There is a need for an action plan. The existing policies are really vague and ambiguous. The government should have developed concrete time bound action plans. This is not the case, however, and it is not clear who is responsible. There is no accountability. (Nepal P10, OPD)*

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The lack of details for the practical implementation of these policies had, in the opinions of stakeholders, two major drawbacks. On the one hand, the absence of concrete plans for how EdTech, AT, and ICT were to be leveraged for the delivery of inclusive education made it extremely difficult for the responsible government departments to coordinate actions between not only different ministries, but also external stakeholders, leading to replication of effort and mismatched alignment between various initiatives. Secondly, many NGOs stated that the lack of detailed policies containing explicit implementation plans with allocation of responsibilities creates problems concerning the transparent accountability of government departments. It is impossible to track the progress of local and national initiatives and monitor how close countries are to achieving the goal of inclusive education for children with disabilities at the primary school level, a point reiterated by a ministry representative from Bangladesh.

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*But for primary, I think every school got a laptop or desktop. But you need to check with the Directorate of Primary Education [DPE], maybe it would be better to check with DPE, that what they have provided. This is another challenge that we don't have access to information from other departments easily. (Bangladesh P1, Ministry of Posts, Telecommunications, and Information Technology)*

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The lack of integration between relevant policies around ICT and inclusive education was also identified as the key challenge in the policy area of the framework by the panel of global experts engaged in the Delphi consultation. Experts pointed out how the disconnect between different government departments can hinder coordination of efforts. It creates a leadership vacuum that can make it harder to drive change effectively, whether streamlining procurement of devices, to creating curricula that integrate technology in inclusive education or ensuring the development of adequate technological infrastructure for schools and homes.

### **Data as key to successful policy development**

If the lack of implementation plans was seen as a key roadblock to the successful application of policies, the unavailability of relevant data was generally considered a major difficulty in developing comprehensive policies. Many stakeholders highlighted the paucity of data surrounding

the EdTech needs of children with disabilities, making it difficult to develop plans for large-scale interventions or develop articulated policies and argue for the appropriate allocation of funding when government budgets were decided. Ultimately, without the necessary data about the presence of learners, their national and regional distribution, and their learning needs, including the need for AT or EdTech devices, some stakeholders find it difficult to establish precise national targets and estimate the amount of funding needed to achieve them.

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*We don't know the exact number of students who need devices and what kind of devices they need. So, we decided to start working on making the content accessible. After this, then we can look at how we can go into providing technologies and other devices. But this will necessitate a study to understand what is needed and technical expertise which we do not have now. (Rwanda P16 Ministry of Education)*

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It is important to note that the lack of data extended to the current availability of devices, the state of technological infrastructure in schools around the countries, and adequately trained teachers that could support primary school children with disabilities. Moreover, even when general data about prevalence and distribution of disability at national level existed, these lacked the sufficient level of details that stakeholders needed to plan interventions.





Source: Shutterstock.

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*So what makes it difficult here in Ethiopia is we can't find the specific statistics. For example, we don't know how many visually impaired kids are out there, how many of those have access to a mobile device, and if they have the devices, do they have access to the internet. We don't have these stats. (Ethiopia P7, start-up innovator)*

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Finally, data and research are also essential to evaluate the effectiveness of programs and interventions that have been implemented in the country and to help develop and share best practices that can maximize the access and impact to ICT for inclusive education for learners with disabilities, as one government respondent from Nepal notes.

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*Action researchers are really needed to understand what works and what does not. Such researchers are really essential to progress in using technology and ICT in education especially focusing on children with disabilities. However, we have not been able to conduct such research. In the absence of such research, we do not exactly know what to promote (and what not to) to achieve our goal of providing inclusive education for children with disabilities using technology. (Nepal P14, Ministry of Education)*

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## **BOX 4: Country-Level Experiences and Insights: Policy**

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### **ETHIOPIA**

Stakeholders reported that the policy landscape in Ethiopia presented two major barriers to the adoption and use of ICT for inclusive education. The first one was the lack of an importation tax exemption for EdTech devices, which significantly increased the cost associated with most necessary technologies, as the in-country manufacturing capacity for this particular sector was relatively low. Secondly, policy frameworks around the use of technology for inclusive education seemed to prioritize secondary and higher education, whereas the introduction of ICT in primary schools, especially for children with disabilities was still seen as a relatively low priority, making it less likely to be the subject of ambitious programs and initiatives.

### **KENYA**

The policy framework for Inclusive education and ICT use is rather comprehensively structured. In comparison to other countries, the government of Kenya was highly committed to ensuring that the education of primary school learners with disabilities are educated in mainstream rather than special schools. Of central importance to this are the Educational Assessment and Resource Centers (EARCs), which are responsible for screening children with disabilities, assessing AT and EdTech needs, and supporting the development of individualized educational plans. However, many of the EARCs, especially in rural areas, lack the necessary financial, material, and human resources to appropriately assess children with disabilities for more complex learning needs. They rarely have access to adequate EdTech resources that would enable them to test the use of different EdTech to find the best match for children's needs. Finally, EARCs tend to operate almost independently from each other. To date, there is no national structure that would enable them to collect and share comprehensive data concerning the functional and educational needs of children with disabilities.

### **NEPAL**

Following the devolution process, the responsibility for the delivery of primary school education for all children was shifted from the Ministry of Education to local government offices responsible for different regions. According to the stakeholders interviewed as part of the research, this has created an interesting situation in relation to the development and implementation of policies related to ICT for inclusive education, with both positive and negative aspects. On the one hand, local governments generally have better connections with local educational institutions and better awareness of regional challenges and dynamics, including languages and infrastructural aspects that are significantly varied in Nepal. This tighter relationship is useful for implementing policies. However, the drafting of national educational and ICT policies still falls under the remit of central ministries of Education and ICT who don't always have comprehensive oversight of the different activities and challenges faced at the local government level. This creates a potential disconnect between the formulation and implementation of policies around the use of technology for inclusive education of children with disabilities.

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## Place

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### Disparity between types of schools and different locations

Across the five countries, the ability of primary school children with disabilities to access ATs and EdTech was strongly linked to the type of school in which they were enrolled and their location. Despite all countries having policies that encouraged the inclusion of learners with disabilities in inclusive government-run primary schools, the research consistently found that special schools, which were usually catered toward learners with a particular type of impairment (e.g., visual, hearing, or mobility), were better equipped, prepared, and more accessible to children with disabilities. Furthermore, special schools were not only more likely to have access to ICT for inclusive education and specific AP, but also most likely to be staffed with teachers that were better trained and able to offer support to children, which directly impacted the learning outcomes of the primary school level students in these schools.

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*When we look at the national examination results and examine how students with disabilities performed, it is clear that students in special schools perform better than those in inclusive schools because they have enough materials compared to those in inclusive schools. (Rwanda P21, Ministry of Education)*

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When prioritizing challenges affecting national and international educational systems, the global experts identified the

disparity between inclusive and special schools as a key obstacle to be addressed in this area of the framework. It represents a strong indication of stigma in many mainstream and inclusive schools, which promotes the segregation of children with disabilities from their peers. This disparity is often compounded by a series of mechanisms that reinforce the gap. Examples include unequal allocation of funding and resources in favor of special schools or staffing patterns that facilitate teachers with expertise in disability to be hired in special schools, rather than designated inclusive schools, despite policy recommendations.

Unequal access to ICT for inclusive education was not only linked to the type of primary school that children attended, but also to the location of the school. In all countries, access to appropriate ICT for inclusive education was significantly less likely to be available for children who attended schools in rural and remote areas compared with those in urban areas. This was primarily due to infrastructural challenges ranging from inaccessible school buildings to lack of electricity and internet connectivity, but also reduced penetration of devices and limited training opportunities for teachers. For example, access gaps were identified between urban and rural areas in Rwanda for radio (72 percent versus 62 percent), mobile phones (97 percent versus 88 percent), computers (12 percent versus 0 percent), and internet connectivity (28 percent versus 2 percent) (Kimenyi, Chuang, and Taddese 2020). Infrastructural challenges were common to all schools—special and mainstream—in both urban and rural areas, but were more prominent in schools located in more remote regions across all five countries.

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*In the public school system in Kenya, I mean, the further you get away from Nairobi, the more difficult the situation is, for the schools, some of them really suffer. Some of them don't have enough teachers, some of them don't have enough desks. (Kenya P4, NGO)*

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Even in the switch to remote learning during the school closure period, stakeholders stated that the learning opportunities available to children with disabilities were significantly different depending on the type and location of their school, which has negative implications for the widening of educational gaps.

In Ethiopia, for example, most private schools in urban localities did find temporary solutions to continue instructing their students from a distance by uploading reading materials and assignments through Google Classroom and e-mail and by using social media platforms such as WhatsApp and Telegram. However, there seems to have been little in the way of similar efforts by public schools in either urban or rural areas. It has been argued this is largely because the majority of public school teachers and parents have limited or no access to internet connectivity, and teachers were not prepared to work in such unprecedented circumstances (Tiruneh 2020).

In general, a gap was detected between public and private schools where both teachers and learners had better access to devices and connectivity essential to access the lessons beyond those provided on radio and TV by government bodies.

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*Almost all public schools are closed and all children are out of the education system. The private schools in particularly urban areas are however doing online classes. This is going to widen the existing education gaps between haves and haven't. (Nepal P11, School Management Committee Federation)*

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### **EdTech access beyond schools**

Although for most children with disabilities, schools worked as a gateway to being assessed for, and provided with, many suitable ATs and EdTech, many stakeholders highlighted how a considerable number of children in all five countries were unable to access school in the first place, either as a result of long-term closures, such as during the COVID-19 pandemic, or on a permanent basis due to community stigma, physical barriers, or a variety of other reasons. This means that those children who were unable to access schools were also unable to access the technologies they needed for learning. In general it is worth noting that while APs, such as hearing aids, wheelchairs, and glasses, were typically provided to the child through provision pathways that often depended on the schools, EdTech, such as computers, tablets, or screen readers, were provided to the school rather than the learner. As a result, when school closed during the pandemic, many children lost access to their EdTech devices, which remained behind the closed doors of their institutions. In addition, although some programs for remote learning included the distribution of educational material



to learners' homes, many of the more expensive and sometimes important pieces of EdTech for learners could not be accessed for prolonged periods.

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*Some students who rely on available materials in the resource room were not able to access the materials. We have students with visual impairment who use our computers with JAWS (a screen reading software) to learn, they could not access the computers. (Rwanda P3, Academia)*

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Stakeholders also stated that many of the infrastructural challenges related to schools were also present for students attempting to follow remote learning programs from home. Additionally, losing the supervision of teachers and interaction with peers was extremely difficult for many children with disabilities. It exposed them to the risk of further isolation in their homes and communities.

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*Children with disabilities in rural areas were unable to learn this education online using technologies because very few children, few farmers, and families have a radio and television. Generally, there are lack of infrastructures regarding technology. (Ethiopia P5, Teachers Group)*

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However, some stakeholders perceived that some community and home-based education programs had also been successful, as they enabled organizations to reach learners with disabilities who are normally excluded from primary schools. These successful approaches were often supported by technology ranging from simple phone calls, WhatsApp groups, videoconferencing software, or social media platforms that enabled the creation of a network of communication between parents, teachers, community members, and learners. They were characterized by their relatively small size and strong participatory component, as illustrated by one of the parents from Nepal.

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*I started online classes for children with disabilities. Only three children participated in the beginning. Now the number has reached to 15. Families are also helping their children's learning process, and they also get involved in. We developed our own curriculum and shared with the parents. So they know what to be done on a particular day so that they also contribute to making the learning material ready. For example, if we are doing art drawing work, parents make materials ready. For example, paper, colors... (Nepal P4, Parents Group)*

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## **BOX 5: Country-Level Experiences and Insights: Place**

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### **BANGLADESH**

Stakeholders from Bangladesh reported that many children with disabilities struggled to access school and being provided with the AT and EdTech they needed to support their learning. Especially when moving away from the capital and toward more remote areas, the infrastructure is also quite poor, with lack of suitable buildings for schools and limited coverage of electricity and internet connection. Some of the regions facing greater infrastructural challenges are one of the islands in the Bay of Bengal. As one example of addressing some challenges, the Bangladesh Rural Advancement Committee, an NGO, has begun to leverage existing buildings, in particular clubs to work as schools during the day as they often feature open spaces that are more likely to be accessible and connected to electricity and internet.

### **KENYA**

Geographical location plays an incredibly important part in the likelihood of children with disabilities to have access to ICT for inclusive education and ATs necessary to support their learning. In the central region of Kenya, close to the capital, a greater number of inclusive schools have both access to electricity and generally reliable availability of mobile connectivity. However, schools in the rural region had very limited access to internet connection or electricity and no availability of devices. Several stakeholders also pointed out how schools in rural areas were also more likely to be highly oversubscribed making it extremely difficult for teachers to offer appropriate support to students with disabilities when needed. EARCs operators in remote regions had also very limited knowledge of EdTech, which hinders their ability to make recommendations for learners with different disabilities.

### **NEPAL**

Possibly due to the more distributed organization of the education system, stakeholders reported fewer regional disparities compared with other countries when it came to access to ICT for inclusive education for primary school learners. However, gaps between rural and urban regions still existed. The presence of regional spoken and sign language created challenges for the distribution of educational material and the accessibility of national education portals created to support remote learning during the pandemic. To mitigate some of the challenges created by the relatively poor technological infrastructure in Nepal, some organizations developed successful programs for community schools and reading groups leveraging small networks that usually remained connected, combining the use of mobile phones and where possible home or community visits.

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## Provision

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### Lack of stable and coordinated funding

Stakeholders in all five countries unanimously raised concerns about the lack of funding to appropriately support the many changes that would need to be implemented to improve the situation significantly. Several interviewees pointed out that increasing access to AT and ICT for primary school children with disabilities is simply not seen as a priority, compared with other pressing needs that countries have been facing, especially in light of the ongoing pandemic.

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*The government does not allocate money for the education of children with disability for technology advancement. Policy makers may think that the investment for the children with disability somehow goes in vain. They think like that because it has not proof of productivity. (Nepal P1, OPD)*

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Others have also highlighted that although funding might be available for increasing access to technologies in schools, this is often not inclusive of children with disabilities, as investing bodies grapple with the need to balance addressing the specific needs of learners versus the need for demonstrating the biggest impact they can deliver.

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*Primarily, you know, when we talked about education and training, we always emphasized on developing tertiary level people. And people who are in government services. But actually if you talk about primary education level audience, we didn't have many programs where actually*

*we addressed the needs of the primary students. (Bangladesh P1 Ministry of Posts, Telecommunications, and Information Technology)*

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This tension often leads to the exclusion of most marginalized learners, especially children with more severe disabilities who are seen as “too costly” to be included in many programs. Moreover, innovators and entrepreneurs from private companies and start-ups have stated that they face significant difficulties when attempting to enter the AT or ICT for the inclusive-education market given limited opportunities to generate sufficient revenues to create sustainable business plans.

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*The other big challenge for us to do with special needs education was kind of a market-based approach. So, we are a private company at the end of the day, and somebody has to pay us for it. And most of the conversation usually is dominated by non-revenue generating agencies like governments or non-government agencies. (Ethiopia P10, start-up innovator)*

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Governments occasionally provide dedicated funding for inclusive education, which is targeted directly to the child, but these schemes are not sufficient to cover the existing need. For example, in Bangladesh, the Ministry of Social Welfare implements a stipend program for students with disabilities. However, financial incentives remain low and with limited coverage (Thompson 2020). Moreover, during the pandemic, those who were already receiving disability assistance were denied access to COVID-19 specific social protection (Rohwerder et al. 2021).

This viewpoint was echoed by the global experts in the consultation for consensus building. Lack of dedicated funding was identified as a key barrier to the appropriate provision of ICT for inclusive education for primary school children. Experts specified that, rather than simply attempting to increase the amount of money that is invested in initiatives around ICT for inclusive education for primary school children, what is actually needed is developing mechanisms that allow for better coordination between different initiatives to maximize resources and align goals. It is also important to promote more stable funding streams. At the moment, a large portion of funding is provided in the form of grants or charity donations, which can create problems of sustainability once the grant expires and the funding runs out.

### **More focus on things and schools with less on children and intangible resources**

When stakeholders were asked how the available funding for increasing access and impact of ICT for inclusive education in primary school is usually invested, what emerged was an overemphasis of financial allocation toward products (both physical and digital). This often occurs at the expense of more intangible resources, such as the training of teachers, caregivers, or learners; curriculum adaptation; improvement of the technological infrastructure; adaptation of learning material; and other important activities. Even when it came to the purchase of accessible devices for ICT for inclusive-education access, very few initiatives included resources to cover potential maintenance and repair costs, which can negatively affect the longevity of a project.

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*Maintenance is another problem—no personnel to maintain the core devices, many said that what you realize is that even when they did the laptop projects in 2016 and 2017, the laptops or the tablets in schools ended up not in good working condition. They were just lying in the store with nobody to repair. (Kenya P7, Teachers Group)*

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Finally, most of the funding provided by government and other organizations to improve access to education for primary school learners with disabilities, which should cover access to AT and accessible EdTech, is provided at the school level rather than to the child. The only exception is individual scholarships or devices that are sometimes provided to students by government or other organizations. Government funding is usually in the form of capitation grants based on the number of students with disabilities. These capitation grants are usually a fixed amount rather than being based on the needs of the child. This means they are not necessarily linked to a particular child or their needs, nor that they have to be spent on EdTech or AT, for which they would often be insufficient, as a ministry representative from Kenya notes.

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*So with KES 2300,<sup>10</sup> a school is free to use it to buy, for instance, whatever AT that it may deem fit. But the reality is that it doesn't even get to that; it usually is over when it comes to very, very simple learning materials. And it rarely gets to the point of covering issues of technology. (Kenya P10, Ministry of Education)*

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10 The standard capitation grant per year provided by the government to support children with disabilities.



## **BOX 6: Country-Level Experiences and Insights: Provision**

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### **ETHIOPIA**

Through the General Education Quality Improvement Program, funded by multiple donors including the World Bank in 2011, the Ethiopian government built resource centers incorporated into inclusive schools around the country to support the education of primary school learners with disabilities. However, stakeholders from OPDs and NGOs have reported that many of these centers lack expertise and have limited access to ATs and EdTech. Most of them lack the financial resources to keep themselves up to date as technology continues to evolve and new skills and products are required to address the needs of children.

### **KENYA**

Public primary schools have access to capitation grants provided by the government based on the number of children with disabilities enrolled. These grants are relatively small (about K Sh 2,300 [equivalent to US\$21] per year), and they are supposed to cover the various educational needs of children, which is often not sufficient to cover EdTech. Some donor-based initiatives, such as the Digital Learning Program (or One Laptop Per Child), have focused on the distribution of EdTech. Unfortunately, due to the lack of supporting measures to provide training and ensure access to technological infrastructure and the availability of accessible material, they had very limited success for learners with disabilities. Finally, NGOs have been providing EdTech to learners with disabilities and offering adequate support in terms of training, availability of accessible educational material, and maintenance services. However, due to the limited capacity of organizations, these initiatives, such as the distribution of the Orbit Reader, are generally smaller in size and focused on learners with a particular type of impairment.

### **RWANDA**

Similarly to Kenya, a capitation grant system in Rwanda provides additional funding to schools depending on the number of enrolled children with disabilities (RF 2,750; US\$2.76) per term compared with RF 1,250 (US\$1.25) normally allocated to students without disabilities. However, as seen in Kenya this funding is usually not sufficient to cover children's AT and EdTech needs. Schools are occasionally provided with EdTech equipment through funding from international donors and NGOs, either as a one-off charity donation or as a grant that only lasts for a limited time. Other international organizations, including the World Bank, are supporting government in the digitalization of educational material. Unfortunately, funding is limited to support the upgrade of the technological infrastructure for schools and homes that would be needed to ensure better connection to electricity and the internet, which is particularly lacking in rural areas.

## summary of findings

The findings from the landscape review show how the level of access and the impact of ICT for inclusive education depend on a variety of interconnected factors involving multiple aspects that can be mapped along the dimension of the 6 P's framework.

As part of the modified Delphi exercise, a consensus was built among global experts around the challenges grouped under the six key themes that need to be overcome to ensure that learners with disabilities are fully able to access and benefit from ICT for inclusive education. The identified challenges are as follows:

- ✦ *People:* Teachers, parents, and other educational support figures lack sufficient expertise in inclusive education and ICT and access to resources to successfully assist children with disabilities in accessing and taking advantage of EdTech.
- ✦ *Products:* Most EdTech devices and software are too expensive for families and schools, limiting their affordability and accessibility. Many products also fail to be truly inclusive of children with more complex needs, are poorly aligned with national curricula, or are inappropriate for the context of use.
- ✦ *Pedagogy:* There is a lack of understanding about the useful pedagogical approaches and simple and reliable assessment practices to assess the educational needs of children with disabilities or which pedagogical approaches (and tools) will be most effective. Nor are there often mechanisms in place to monitor their progress in order to ensure that any adaptations, including technology provided, positively impact learning experiences.
- ✦ *Policy:* Existing policies for Inclusive education and ICT are often separate and poorly integrated, which makes it difficult to coordinate actions across government bodies with fragmented responsibilities and between actors working in different areas.
- ✦ *Place:* Inclusive and mainstream schools struggle to access the necessary equipment that students with disabilities need, and teachers often lack the inclusive-education training that leads to a risk of further marginalization of students with disabilities.
- ✦ *Provision:* Funding mechanisms for initiatives focusing on ICT for inclusive education are often project-based and rarely combine a comprehensive attention to all the necessary components of successful implementation from creating adequate technological infrastructure to providing training and maintenance for the correct use of devices. This leads to poor sustainability of many initiatives and reduces the potential impact of many implemented projects.

# 07

## discussion of key needs

Emerging from findings drawn from multiple primary and secondary sources and gathered through several complementary approaches are a variety of needs and factors to be addressed in order to use ICT to improve the learning outcomes of children with disabilities in LMICs.

Emerging from the 6 P's framework are four interlinked components that, if addressed, will help improve learning outcomes as well as improve inclusion of children with disabilities within the wider EdTech ecosystem.

**Chapter 7 structures and discusses these requirements along the four components:**

- ✚ systems strengthening and market shaping to systematically improve the provision of inclusive education and reduce the cost of AP;
- ✚ open innovation for an improved technology infrastructure;
- ✚ community, family, and out-of-school learning support; and
- ✚ better data and evidence.

## systems strengthening and market shaping

ICT for inclusive education sits at the intersection of many different disciplines and sectors. This can result in difficulties in coordinating efforts with huge implications for policy development, funding, and evaluation that severely hinder the sustainability of initiatives.

To tackle this challenge, collaborative international, national, and local implementation plans are needed that clearly outline the responsibility of different parties, include a joint and comprehensive definition of success, and incorporate accountability mechanisms to monitor progress and evaluation. The World Bank's approach to the "connected learner" (Hawkins et al. 2021) sets out a roadmap. It advocated for a "whole-of-government approach" to support the provision of the right policies and resources. Funding is crucial to delivering this. The authors specify the need for ministries (e.g., of education) to work across government to review policies on reducing connectivity costs and increasing access for schools. This should also include ministries of health and social welfare to ensure access to AT.

A key lesson to learn from other countries is not to make AT the responsibility of just the Ministry of Health or health insurers and social services. This risks their interpretation as a medical need, perpetuating medical (and charity) models of disability. Rather, these devices would be seen from a rights-based perspective as a technology essential to overcoming barriers (Hersh and Mouroutsou 2019, 3340). Taking a

broader approach may also lessen the stigma often associated with using AT or EdTech and align with that of the learner as a connected child.

In general, in the five countries reviewed, policies are in place to support the inclusion of children with disabilities, but they are rarely integrated across other sectors, such as health or ICT. It means there is a lack of responsibility and a lack of resources outside of these sectors, yet children with disabilities need multidisciplinary support. Furthermore, across the board, while policies have the potential to effect change, monitoring and evaluation processes for their implementation are often weak and lack of clear lines of responsibility for delivery. Policy making is rarely effectively joined up or coherent, which leads to a lack of responsibility by line ministries and ineffective budgeting mechanisms. Therefore, even if there are intentions to deliver a holistic approach, implementation remains weak, and despite intentions to the contrary, policies often remain siloed as lines of responsibility are unclear. Development of targets and indicators in national development plans may facilitate this, as well as draw attention to responsibility.

*The Inclusive Education Resource Guide: Ensuring Inclusion and Equity in Education* gives the example of twin-track and disability-responsive budgeting to support more strategic use of existing resources and the development of formulas that account for the costs of including learners requiring reasonable accommodation or support services (Alasuutari et al. 2020, 31), as well as links to tools. Inevitably the COVID-19 pandemic has had an enormous impact on education funding, which is described in detail in *Pivoting to Inclusion:*



*Leveraging Lessons from the COVID-19 Crisis for Learners with Disabilities* (World Bank 2020a). Advice is divided into current and future funding guidance and focuses on persons with disabilities as a “vulnerable group” along with girls, refugees, and children from low-income families and remote locations (World Bank 2021, 50), making the connections between household poverty, lack of assets, and vulnerability. Here social protection mechanisms and incentives are promulgated within a multisector approach to education financing, which specifically targets children with disabilities and their families.

In the five countries reviewed in this report and in others, limited mechanisms are currently in place that effectively identify and assess children with disabilities. More attention is needed on joining up identification mechanisms (e.g., OPDs as the first point of contact for disability ID cards) to broader services, including AT and EdTech. Finally, the World Bank report also calls for strengthening EMIS data that can be used not only as an overall tool for future planning, including the type of EdTech that might be required at the classroom level, but also as an entry point for identifying children with disabilities; though they are not in themselves diagnostic.

Shifting the focus of education away from bricks and mortar schools may increase some of the challenges associated with technology, not least the reduced socialization and activity. However, there are also benefits to doing this for learners with disabilities, not least the issue of how they actually get to school in the first place. Lack of accessible and inclusive transport is often cited as a barrier to education for learners with disabilities (Kett and Deluca 2016), yet AP (or indeed accessible design) are rarely thought of as EdTech. A clear

division doesn’t exist between what is AT and what is EdTech; nor is there an agreed list of products as there is for AP (WHO 2016). Hersh and Mouroutsou (2019) give the example of the debate around whether all forms of AAC fall into AT, rather than EdTech. In the online survey, the vast majority of categories and types of EdTech cited by respondents were already included in the WHO APL (including AAC). However, since the APL has only been recently adopted in some LMICs, no data are available yet to support the claim of a positive impact on inclusive education.

Lynch, Singal, and Francis (2021) call for a consultative process to create a priority list of EdTech that can support children with disabilities. This is also in line with the World Bank Guidance Note on disability-inclusive education, which calls for stakeholder engagement and feedback loops to be established with persons with disabilities or OPDs throughout the design and implementation of projects. The WHO APL has the advantage of buy-in from a range of stakeholders; however, there is still a need for wider EdTech ecosystem engagement to ensure affordability, investment in EdTech infrastructure and technology for schools; clear guidelines on who is responsible for sourcing technology; and high-quality competency skill training in EdTech for teachers (Lynch, Singal, and Francis 2021). Encouraging ministers and officials to think from a UDL approach, rather than seeing inclusive education as solely focusing on children with disabilities (as this research indicates that many currently do), would be a pivotal shift. This will not obviate the need for specific EdTech for some learners but may begin to shift the perspective away from the homogenous “learners with special needs” to more individualized approaches.

The key to personalized learning is the comprehensive assessment of the child in terms of their capabilities, educational needs (including technology), learning styles, and personal preferences. Technology should support this individualized assessment process and enable collaboration between the child, their families, teachers, and all the other different professional parties involved to collaboratively develop and implement learning pathways that can be adapted and modified as the circumstances of the child change (either as a result of individual progress or wider situational factors). EdTech should also enable the provision of individualized support as, and when, it is needed by the child, promoting interactions between learners and teachers, but also among peers. Ultimately, technology should increase children's agency and empower them in a supported way to learn in a way that suits their needs and preferences.

There is no magic bullet piece of technology that can improve the education of children with disabilities—each child has their own needs, capabilities, and capacities. While there is evidence that some technologies improve learning outcomes for some children, the focus needs to shift from the “tech” itself to the process of inclusion and the specific needs of the child. A key finding of this research is that often problems are structural and systemic, with very limited data on learners' needs, the state of the technological infrastructure, and availability of human and material resources. These are combined with poor linkages between leadership, policies (such as for ICT and education), and sectors. These issues have all been exacerbated by the ongoing coronavirus pandemic.

From the evidence presented, there appears to be an ongoing gap between health-focused assessments (especially in the early years) and other assessments, with the major emphasis on school-based assessments, such as the EARC system in Kenya. While this may be related to the siloed approach to budgeting, common in many LMICs, a shift is needed to a more child-focused assessment, ideally in the community setting. A clear gap exists between early childhood assessments (and interventions) and school. Even if children are identified pre-school, it is unclear if support or resources follow them to school. For those children with disabilities who are fortunate enough to go to school, their EdTech requirement may be identified and even supported there. But, as noted earlier, in this model, funding is directed mainly to the school rather than to the child, which in practice is often not used solely for the intended child, nor is the funding likely to be enough for some specific devices or EdTech. Adequate funding that goes directly to the child would be more helpful to support personalized learning.

Various mechanisms that could be employed to support this include the use of social protection structures, as indicated in World Bank 2020a, or provision through community health or development workers. Assessing children for potential impairments is a gap in the skillset of community health workers (McCollum et al. 2016; Naidoo, Taylor, and Govender 2019), though some simple tools to do this are already being piloted (Hatch and Dombrowski 2019; Tekola et al. 2016). However, most are impairment-specific, and the development of simpler community-level (potentially digital) assessment tools is essential.

Particular gaps in the literature are found around the roles and impact of allied professional staff (e.g., physiotherapists, occupational therapists, and speech and language therapists). What little evidence there is rarely focuses on their role within the education system, or how they could be a conduit between systems. Similarly, the recent global survey conducted by the World Bank IEI has also highlighted the need for more coordination among educators in schools, for example, between special education teachers and mainstream teachers (World Bank 2021). Finally, it is worth highlighting that these interventions should not be seen as one-off assessments, but rather need continuous review and updating over the life course. Such an approach aligns with the need for joined-up services and resourcing, including social protection across the life course.

At the same time, interventions should aim to increase digital fluency and build capacity of parents and teachers to increase their awareness of EdTech and enable them to use technology to support learning, ensuring continuity of education even in the face of disruptions. Shifting to a more individualized, and less rigid, way of teaching has been triggered by the COVID-19 pandemic. Despite the possibility of the government training or retraining teachers on ways to adapt lessons, little evidence was found that accessibility, AT support, or inclusive-education methodologies would be included in this training. This is a missed opportunity to improve learning outcomes overall and risks widening the learning gap more for learners with disabilities specifically.

It is clear from the research that more engagement of parent and caregivers is needed, not only to support the learners themselves, but also to facilitate the

ecosystem approach. The online survey highlighted the information gap around EdTech, particularly in how to use it, with a significant minority having to teach themselves. Parents and caregivers must have the necessary information to know how to address their children's needs and rights, as well as the wherewithal to complain if they are not being upheld. Strengthening community engagement to monitor educational outcomes for learners with disabilities, for example, through the use of "disability helplines" as recourse mechanisms may be useful approaches (United Nations Secretariat 2021, 15).

Making all content more accessible, inclusive, and adaptable will benefit *all* learners in the classroom. This does not obviate the need for specialist assessments and devices for some children with impairments, nor more targeted support for those falling behind, but it would begin to address some of the wider classroom challenges. However, there is a big caveat here, as teachers already bear the brunt of education failures and are blamed for their limited digital skills or knowledge about pedagogical approaches.

Teachers and learners need to learn how to use technology and how technology can enhance learning ("learning to use technology and technology for learning"). It is clear from interviews that inclusion is often only understood to mean children with disabilities and is often decontextualized from local realities, which inevitably include large classes, limited resources, and difficult working conditions. As McKenzie et al. (2020) note, capacity building of educators should not just be about developing UDL skills, but contextualizing it as well as strengthening leadership in UDL (McKenzie et al. 2020, 53). Key to

this is using local resources, materials, and other low-tech tools and devices and working with parents, caregivers and the community. Teachers also need not only to be encouraged and empowered to leverage appropriate AT and EdTech for students with disabilities, but also to undertake any reasonable accommodations that might be required, an aspect often neglected in the classroom and elsewhere. However, giving teachers the confidence to deviate from rigid and inflexible assessment-based approaches requires buy-in for all stakeholders, including ministries and donors.

Funding, identification, and assessments are core necessities to ensure children (and adults) with disabilities get the right AT they need. But as yet, this research shows this is an area that still needs more evidence about effective approaches as well as more resourcing for professionals in the field. The move by the government of Kenya to provide minimum quality standards for Educational Assessment and Resource Centers (EARCs) reflects this need. While the major source of education funding is from governments, households are also significant contributors. Development partner contributions are often the smallest share, but do hold significant power as they are likely to contribute to other sectors of the economy (World Bank 2020b). Yet according to the online survey, NGOs were the most likely provider of EdTech, followed by government agencies and self-acquired. However, private vendors, such as shops and markets where people can buy products directly as well as tech companies or innovators, are rarely included in discussions around EdTech ecosystems. While donors may make suggestions as to what needs to be done to increase inclusion, little discussion is seen in the literature about

fundings' responsibilities. Arguably, donors could do more to redress these gaps and mandate specific inclusion responsibilities as part of funding requirements. To ensure buy-in from countries, this aspect needs to be part of a wider discussion about attainment of development goals and equality of all citizens.

## **open innovation to improve technology infrastructure**

EdTech should be designed to support learning in a way that is inclusive of children with disabilities and should be developed in partnership with children, parents, teachers, and other relevant stakeholders.

Adopting an inclusive and collaborative approach will lead to greater acceptability and enable better integration with existing curricula and ensure that technology is contextually appropriate to the learning setting in which it is used. Moreover, open approaches to innovation and EdTech development based on partnerships between different stakeholders and knowledge sharing could allow for the creation of shared resources that can be leveraged, adapted, and recontextualized by providers promoting scalability without adopting a one-size-fits-all approach. The creation of standards and guidelines for the development of EdTech innovations is a key step in this direction. The promotion of open and inclusive innovation approaches could significantly help to maximize the impact of ICT for inclusive-education innovation.



The [World Bank EdTech Strategy's](#) roadmap highlights the need to avoid technology and vendor “lock-in,” which is crucial in the rapidly changing AT and EdTech worlds as product specifications change rapidly, requiring expensive upgrades. It is important to get the right technology to the right child in the right place. The right place may be school, but it may also be home, the community, or elsewhere. There are strong arguments for the child being allocated the device directly to ensure personalization of use and familiarity with applications. A counterargument is that this can remove responsibility for provision from government (Hersh and Mouroutsou 2019). Alternative ideas include that of education as a service (or EaaS), where users can tailor their education experiences around a single point of delivery (Fogel 2010).<sup>11</sup> Mobility as a service (or MaaS) involves a range of providers coming together to provide a single point of access and payment for a joined-up, integrated, and wholly accessible service for users.<sup>12</sup> Similarly, EdTech could be provided as part of the education service through a single point of access and payment, adapting to the child’s changing needs over time.

Seeing EdTech as a comprehensive service could also help to sustain distribution over time and ensure that children have access to resources directly rather than requiring the constant mediation of schools. Another opportunity to leverage is that of devices

with multi-functionality, such as mobile phones with built-in access features. Previous studies from GSMA have shown high mobile phone penetration among people with disabilities in Kenya and Bangladesh (respectively, 82 percent and 62 percent). However, it is important to notice that only 29 percent of these mobile devices in Bangladesh and 26 percent in Kenya are smartphones, including the accessibility features necessary for children with disabilities (GSMA 2019). There are also significant gender gaps in access (GSMA 2020b). Providing accessible smartphones may be more cost-effective in the long term, as they have a range of additional uses and are less likely to need upgrading so often.

From the empirical evidence presented, in the EdTech field, interest is limited from local innovators and entrepreneurs, or indeed private retailers, in part because of limited demand and profitability related to the perception of limited market size. It is hard to identify solutions given limited data and evidence to substantiate what these problems are in the first place, as some innovators point out. Moreover, if parents and caregivers are not aware of either need or availability, then there is less demand in the first place. A lack of incentives and competition is seen around supply. In this area, the consensus of the global expert group spoke to guidance to define EdTech priorities and specifications for those purchasing it as being helpful in terms of

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11 Increasingly the focus for this is on tertiary education, trying to move away from a traditional three- or four-year degree program, to seeing it as a modular experience tailored to the users’ needs over time (<https://core.ac.uk/download/pdf/12824514.pdf>).

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12 For more information on “What Is MaaS?” visit the MaaS Alliance website at <https://maas-alliance.eu/homepage/what-is-maas/>.

procurement and the enabling of market shaping and market making and other incentives, such as procurement guarantees or advance market commitments. However, it should be balanced with the chance to make catalytic, agile, innovative investments. The expert group did not see this as either/or, but rather both are necessary. World Bank colleagues also highlighted the need to experiment with different and more innovative business models. Public-private partnerships involving technology companies in the private sector can be essential to leverage new ICT for inclusive education with enormous potential to scale (e.g., [Google Euphonia](#) and [Microsoft Reading Progress](#)), though to date, many of these services are only available in English and have not been tested widely in LMICs.

Finally, to increase access and impact of ICT for inclusive education, more disruptive innovations, in tandem with overall system strengthening, are necessary. This will require a shift in how the needs and rights of children with disabilities are addressed in many LMICs, and it underscores the work the World Bank has been doing on inclusive education and EdTech around the connected learner (Hawkins et al. 2021). This shift will take time, effort, and resources.

## Products

### Cost, appropriateness, and accessibility of physical products

One of the critical barriers that hinders access to AT and ICT for inclusive education for most primary school learners with disabilities across the five countries was simply the high cost of many of these

products. In Nepal, for example, only 3 out of 10 children have access to television, radio, and internet-based learning platforms, and an estimated 45 percent students have no regular access to online or other media (Ministry of Education, Science, and Technology 2020). Most inclusive schools managed by national governments have relatively limited funds and the financial resources of families of children with disabilities are even more limited. High-tech and specialized digital devices, such as advanced AACs, hearing aids, and most high-end laptops and smartphones, are manufactured abroad and need to be imported, which can add significant cost to the already expensive tag price (Tangcharoensathien et al. 2018). Issues around costs are especially significant in relation to the provision of EdTech for children with more severe or multiple disabilities.

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*We are using Braille, hearing aid, magnifying glass to train children with deaf blindness but we cannot access Braille displaying computer because it is too expensive. (Ethiopia P3, OPD)*

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Global experts consulted as part of the Delphi consensus-building exercise agreed that the high cost of many ATs and ICT for inclusive education was the most significant barrier affecting children's ability to access the technologies they need to maximize their learning opportunities. Experts also argue that many providers and donors tend to focus too much on the cost of the device, without necessarily considering the impact that the product might have on multiple activities or learning



Source. Marie Schoeman, Leonard Cheshire.

outcomes. Being able to match the cost of a particular product with its effectiveness in creating educational gains for a child with a disability could significantly impact the perception of a cost. Moreover, as a key to reducing costs of individual AT and EdTech, several interviewees suggested that developers and providers should focus their attention on multi-purpose devices, such as smartphones, which can incorporate multiple features and applications with built-in accessibility capabilities.

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*When we think about mobile phones, we think about high configuration expensive phones. But with the basic configuration you can also buy mobile phones at tk. 2000. Just imagine how much impact that would ensure. (Bangladesh P2, NGO)*

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Global experts, and country-level stakeholders also highlighted the need to distinguish what determines affordability, depending on who is bearing the cost of the device, as the financial resources of donors, governments, schools and families are vastly different. Furthermore, mobile phones, radio, televisions, and other electronic devices available in the household were often shared among different members, creating tension and limiting their availability for educational use.

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*The parents, they don't have adequate devices in one family. If there are three children, then the priority is given to the children without having disability. (Nepal P1, OPD)*

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### **More flexible and adaptable digital devices**

In contrast to physical devices, the availability of digital products was greater, and these technologies were, to a certain extent, perceived to be less affected by cost barriers. Nonetheless, many stakeholders advocated for the need for increasing awareness and availability of open-source products and accessible educational material. Of particular relevance were considerations around encouraging the development and subsequent adoption of digital platforms, tools, and educational material that could support access for learners with different disabilities, but also better fit the context of students with disabilities both in relation to language and the culture of a particular country or region.

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*We are working to make all the content of our digital lessons available and add interactivity features to support students with disabilities. By adding sign language, subtitles and videos, we support three types of disabilities. (Rwanda P19, Ministry of Education)*

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Stakeholders also pointed out how different types of ICT for inclusive education had specific shortcomings that limited their effectiveness. For example, refreshable Braille displays often could only be used to access texts, but did not enable students to explore pictures or other graphical elements due to hardware limitations. Many of the technology-mediated methods leveraged to deliver lessons to children with disabilities remotely offer limited opportunities for interaction, dedicated support, and engagement, all of which negatively affects the student's experience.

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*The ways in which you can interact with that kind of very dry TV or radio kind of lesson is very limited. It obviously doesn't offer any individualized education plans either. It's like it's a standardized, generic kind of curriculum that is done by the radio where children with disabilities don't have any interactions with teachers. There are no adaptations done to suit individual needs, and all kinds of individual barriers. (Kenya P5, international NGO)*

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## BOX 2: Country-Level Experiences and Insights: Products

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### BANGLADESH

In Bangladesh, [Young Power in Social Action](#), along with a2i, [Accessible Books Consortium](#), and the [DAISY Consortium](#), have produced [DAISY digital multimedia books](#), accessible e-books, and digital Braille books for learners from grades 1 to 10. These are more cost-effective than printed books and are accessible for all, including students with visual disabilities, print disabilities, and learning disabilities (UNESCO 2021a). Learners with visual impairments have also been testing MBraille, a new app that helps users learn to read and write Braille. These advancements should lead to apps gradually replacing more traditional forms of AT, such as handheld magnifiers. However, there still needs to be more evidence that they are pedagogically and environmentally appropriate for the target group of learners and can be afforded by the supplier, for example, a national ministry of education (Lynch, Singal, and Francis 2021).

### ETHIOPIA

One of the challenges faced by tech developers who are keen to create new educational products for a diverse cohort of learners is the need to integrate multiple interactive modes to promote accessibility without clashing with hardware limitations common to most devices. For example, the Ethiopian EdTech start-up called BeBlocky has recently been focusing on making their application that supports the learning of basic computing concepts through play accessible to learners with visual impairments. Most platforms that facilitate children in writing computer code use graphical user interfaces that cannot be navigated by audio. BeBlocky has been successfully experimenting with the use of tangible interfaces, such as Braille blocks that can be moved and arranged by children. However, there is concern around the fact that introducing the need for additional hardware might increase the cost and reduce the ability of children with disabilities to access the application. This tension exemplifies how, even when using devices with multiple interaction modes, such as smartphones, there are often challenges in ensuring that EdTech is accessible to learners with disabilities.

### KENYA

Since 2019, the Kilimanjaro Blind Trust Africa (KBTA) has spearheaded the initiative focused on the provision of the Orbit Reader 20, a portable refreshable Braille display. Collaboration with government ensures that the device is distributed to students with educational material relevant to the curriculum already uploaded on it. The plan for distribution has been following a systematic approach starting from primary school students in grade 3 to older students until the end of the primary school cycle. Alongside the device, KBTA also provides training to learners, teachers, and schools technicians so that students are able to access adequate support and maintenance if needed. In the context of the pandemic, the device has been particularly valuable thanks to its portability and long-lasting battery. Students were able to use the device for remote learning. The individual cost of the device is \$650, which could be easily labeled as too expensive by many funders or providers.

### NEPAL

Throughout several of the interviews, stakeholders pointed out how, when it comes to the production of accessible educational material for primary school learners with disabilities, Nepal presented some additional challenges compared with many other countries. First of all, some of the major languages used in Nepal are not recognized by most computer programs in either their written or spoken form, yet they are still used in primary education in some schools. Secondly, although Nepali sign language has been recognized by the Ministry of Education, there are great variations in its use across educational settings in the country. This significant variation of written, spoken, and sign language leads to significant challenges when it comes to producing accessible content for primary school education, especially in the case of technology development where languages need to be appropriately coded for the digitalization process. These challenges are not unique to Nepal. They highlight the need to develop more flexible and comprehensive approaches to create accessible educational material that can be used by children with disabilities regardless of their primary language.

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**NOTE:** The DAISY Digital Talking Book (DTB) is a collection of multimedia digital files that provides an accessible representation of a printed book for individuals who are blind, visually impaired, or print-disabled. These files may contain digital audio recordings of human or synthetic speech, marked up text, and a range of machine-readable files. The structure of the book is designated by the XML tags and is accessible to the reader by use of a browser or a playback device. The DAISY DTB utilizes the technology of the internet with the addition of specialized applications to provide improved access to the information.

## community, family, and out-of-school learning support

Engagement with local communities is key to reducing the disability stigma that still prevents many children with disabilities from accessing education.

The role of ICT for inclusive education is not just to improve the academic learning outcomes of the child, but also to facilitate ways of engaging in intra- and extra-curricular activities, helping them connect with their peers in a motivating and fun way. Play is a vital part of a child's growth and development, helping them learn about others and promoting participation and inclusion within families and local communities.

One example identified through the literature review is the telecommunication model [Pashe Achhi](#) (beside you), developed by the BRAC Institute of Educational Development during the COVID-19 pandemic. This model provides psychosocial support to parents and caregivers and engages with children through playful approaches to learning at home, aiming to mitigate the adverse effects of the situation on children and caregivers (Ahmed et al. 2020). This example and others like it show how technology can support collaborative play and connect children, schools, and communities (Goodwin 2020).

EdTech can support the development of a more engaged education journey that

fosters children's motivation to learn and create more resilient inclusive-education systems that continue outside the school. Schools are of course important not only as learning institutions, but also for socialization and play, and as a place where additional services, such as school vaccination or feeding programs, can be delivered. But, as the pandemic has illustrated, a system that relies exclusively on schools for the delivery, access, training, and use of EdTech is not resilient to either local disruptions whether earthquakes, flooding, or conflict, or more global events, such as the COVID-19 pandemic.

It is clear from the research that poverty has had a significant impact on household resilience to the worst effects of the pandemic, whether because of precarious employment, limited resources or access to online lessons, and limited availability of social protection. Worldwide, children attending private schools have generally fared better than their state educated counterparts.<sup>13</sup> Moreover, evidence indicates that children with disabilities have fared significantly worse overall (World Bank 2020a).

While different countries will have different strategies to address this gap, families and communities will have a considerable role to play in the recovery. Examples of communities coming together to support remote teaching include networks of support in Nepal. But to ensure sustainability, such groups need resources and local government support, including from the education ministries, to ensure they are inclusive of all children and connected to the wider system.

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<sup>13</sup> <https://www.economist.com/international/2020/04/30/closing-schools-for-covid-19-does-lifelong-harm-and-widens-inequality>



Source: Shutterstock.

The research has highlighted the need to engage better the parents, caregivers, wider community, and of course, children themselves. Learning does not only happen in the school, but also at the home and community level. Huge opportunities exist to leverage EdTech to empower initiatives, but with few examples of where this has been successfully done in LMICs. To better support children, EdTech should be part of a ubiquitous learning system accessible in and out of school (at anytime and anywhere), which does not further increase inequalities. Key to this is the engagement of the end-user (the learner). Teachers are part of the community and have a key role to play as users of technology too.

## **better data and evidence**

Another challenge often mentioned, particularly by policy makers, was the limited data about the presence of learners and their specific learning needs.

Significant gaps are still found in data collected at the country level (including EMIS), but much better use could be made of these data, including understanding trends over time and areas of high need. This information could facilitate a better understanding of resource gaps as well as costs, procurement processes, and general market access and availability.

Several other gaps in evidence are apparent from this review. The first is that discussions tend to focus either on general education or special education. Very little documented evidence is available of the impact of EdTech on children with disabilities compared with their peers without disabilities (in particular focusing on intersectional issues of age, gender, location, ethnicity, and so on). Data on this would help more targeted interventions especially in the post-pandemic recovery period. Related to this, more evidence is needed about the process of inclusion. How does it take place? What are the differential impacts (e.g., on sex, age, and impairment type)? What are the barriers and facilitators? Which pedagogical approaches work best? And how can it be taken to scale?

Most of the documented evidence around EdTech is based on the technology itself, rather than the *process* of inclusion (for which the child or children may need AT). More research is needed on how this process takes place, what are the barriers and facilitators, which pedagogical approaches work best, and how it can be taken to scale. Linked to this, most of the measures of impact focus on learning outcomes. This is necessary, particularly post-pandemic, but there is very little discussion— or evidence—of other indicators of inclusion,

such as participation and transition, and the relationship to EdTech or AT. Also needed is research around developing a wider range of outcome indicators and their relationship to EdTech or AT.

Almost all services were delivered at the level of the school or remotely and linked to schools. Yet in all five countries, children with disabilities were more likely to drop out of school or not be in school in the first place. While there appear to be some promising developments around community-level support, little evidence is found of the impact of community-based services and interventions on a larger scale.

Another gap is around the identification and assessment of disability. Even with some areas of good practices (e.g., EARCs in Kenya), a much better connection is necessary between existing child health screening (particularly in early childhood), community-based assessments (e.g., by OPDs), and school-based systems.

Finally, gaps in teacher training are highlighted in much of the literature, although with little evidence of good practice in this area (pre- or in-service teacher training). A systematic review of the evidence would provide a baseline for UDL approaches and highlight areas of potential replicability.





# 08

## conclusion & recommendations for the way forward

### conclusion: a “massive-small” open innovation approach

This study has highlighted the need for the right technology to be received by the right child, in the right place, and at the right time, with pandemic-related school closures offering a window into the possibilities and challenges of teaching all children differently.

**However, the evidence suggests the poorest and most marginalized are among the worst impacted by the pandemic. Unless measures are put in place now, the gaps already experienced in learning by many children with disabilities are only likely to increase and will impact them across their life course drastically, as well as the global hopes of delivering the Sustainable Development Goals.**

Each country is at a different point on the journey to full inclusion. A shift in perspective is required to embrace EdTech as part of the UDL framework, which is contextually specific and will support the inclusive education of children with disabilities. Laws and policies support the rights of children and adults, including their access to assistive technologies, which should facilitate progress in this area.

Structuring the findings around the analytical framework of the 6 P's has helped identify the entire EdTech ecosystem and how each component is necessary for the others. It also has clarified that there is no single magic bullet solution to the questions: Can ICT improve the learning outcomes of children with disabilities in LMICs, and what factors enable or restrict this improvement within the wider EdTech ecosystem? Rather, a multidimensional and integrated approach is needed that puts the child at the center.

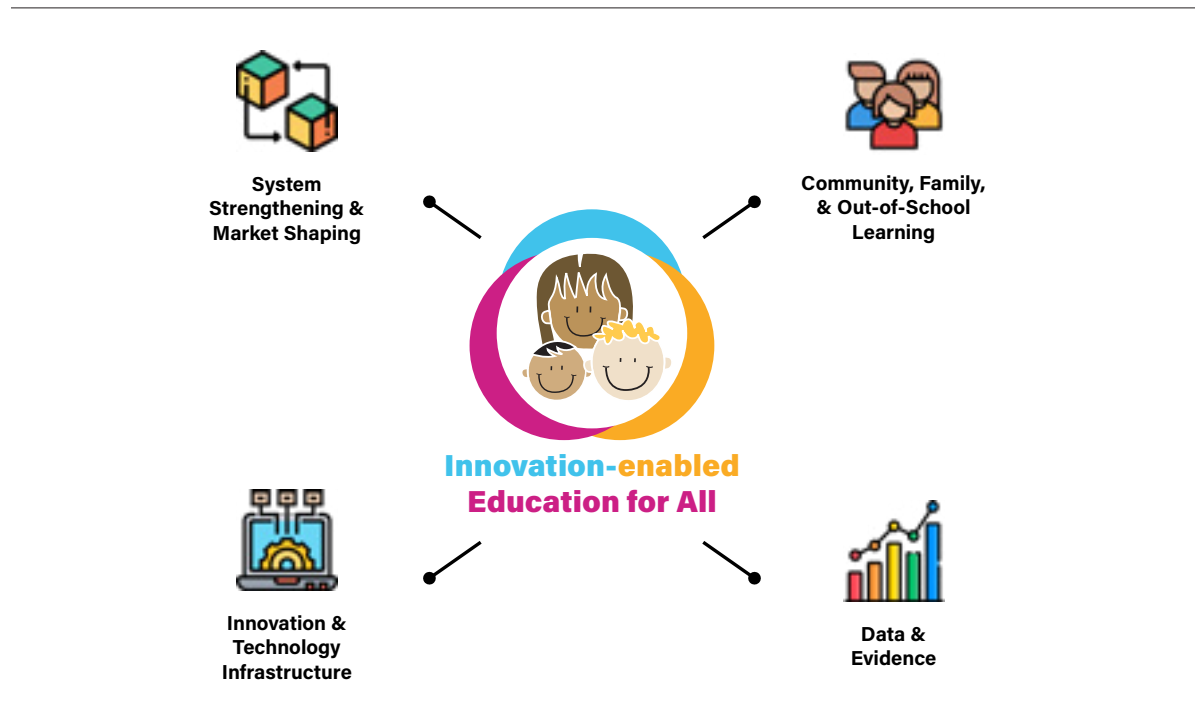
This study highlights the different elements that this ecosystem needs to ensure that children with disabilities are at the center of and genuinely benefit from ICTs in their educational journeys. A robust ecosystem can ensure that the child has access to early and prompt rights-based assessment

that identifies what support they need, including which (if any) EdTech is most suitable to them based on their capabilities, preferences, learning styles, and personal circumstances. Children will have access to appropriate products, which belong to them and can be used whenever they need, that will be updated and upgraded when necessary and as their learning and other needs change. They have the necessary support, training (including digital literacy skills), and services that enables them to fully leverage their EdTech to maximize their learning at home and—crucially—in the community. They will be integrated socially, emotionally, and educationally and have access to increased learning opportunities. These children are part of a broader education system that is aware of their needs and rights, is able to track their learning progress, and targets support accordingly both inside and outside schools.

This review proposes an Innovation-Enabled Education For All approach, which speaks directly to its research findings and the needs discussed. This approach incorporates four interconnected components to be addressed for the successful harnessing of the potential for educational and assistive technology to improve the learning outcomes of children with disabilities. These are: (i) systems strengthening and market shaping; (ii) community, family, and out-of-school learning; (iii) open innovation and technology infrastructure; and (iv) data and evidence. They cut across the education ecosystem, as expressed through the 6 P's (people, products, pedagogy, policy, place, and provision), and highlight the actions required to build collaborations between stakeholders and strengthen learning outcomes across the entirety of the ecosystem. Figure 11 depicts the multidimensional and integrated

Innovation-Enabled Education For All approach. Supported by its four components, the approach is centered around the child.

**FIGURE 11: The multidimensional and integrated Innovation-Enabled Education For All approach**



Source: World Bank.

How interventions for improving access and impact of ICT for inclusive education are delivered also matters. To ensure that interventions are both meaningful and sustainable, the following principles should always be considered:

- ✚ *Adopt a twin-track approach* with both vital and necessary targeted, disability-specific work, but alongside mainstream interventions that adopt inclusive approaches. For instance, mainstream programs around inclusive education or innovation need to work as hard for learners with disabilities as the disability-specific interventions, which should be used to trail and test learning that can be adopted in the mainstream. This will necessitate client-side disability expertise on mainstream projects where large procurements or investments are made.
- ✚ *Forge disruptive partnerships* to engage new and different actors to support innovation. If the current market players could deliver inclusive education, or one or two organizations or private companies could do it alone, it would be done. However, new actors and users are needed, and a collective approach is essential.

- ✦ *Involve and include of learners with disabilities and their families, communities, and teachers* throughout the planning and delivery of any intervention. Like any service or product, it will be made better by their insights, and capacity will be built, too.
- ✦ *Mass distribution of small- scale solutions may address several gaps.* The interventions that are working are small. There is a need to consider how to grow this distributed delivery on a massive scale instead solely searching for the next innovative technology that will work everywhere.

## recommendations

This report contains a series of recommendations around the four components shown in figure 11. The recommendations are specifically aimed at development practitioners, including World Bank staff, government stakeholders, and other development partners.

Finally, recommendations have been extrapolated from the data and are naturally top-level strategic proposals. To implement them, additional contextualization will be required to bring this to life in the local, national, and regional context. In keeping with other similar approaches, such as the WHO GATE AT tools, specific technology requirements are recommended. The prioritization of these would be subject to discussion and debate with key partners at a country level. Tools can support this, as can overarching prioritized technology lists. Although the scope of this research was

not to deliver either, this could be a next step identified under the recommendations. Local innovation mapping and data collection will also be helpful in supporting local implementation along with community engagement. In short, the components of the recommendations will warrant discussion in context to facilitate local-level priorities for implementation.

### RECOMMENDATION 1

**Strengthen systems and shape markets to systematically improve the provision of inclusive education and reduce the cost of assistive ICT for inclusive education products. Actions to consider are the following:**

- **Develop ICT for inclusive-education product guidance to support procurement and purchase. This could include:**
  - ⊕ Developing a guidance toolkit on selecting priority products at a country level and drawing heavily from the existing APL and approach. Such a listing of products could be blended into the next iteration of the Priority Assistive Products List or incorporated into a specific EdTech Global List.
  - ⊕ Ensuring existing procurement guides or product accessibility standards are fit for purpose, filling any gaps to support governments in procuring appropriate ICTs of inclusive education and including training and support to those procuring such products within countries.
  - ⊕ Advocating and making provision for a shift in provision—from the product provided to the school, to the product provided to the child—which



is necessary to enable the child to continue learning outside of the school setting.

- **Invest in and develop country-, subnational-, and local-level tools to assess current country capacity, procurement, and need for ICT for inclusive-education products.<sup>14</sup> Specific interventions might focus on:**

- ⊕ Considering mechanisms for pooled procurement between countries and regions on specific products.
- ⊕ Collaborating with UNICEF to identify what products could be supported through the Procurement Catalog and School in a Box scheme.

- **Develop ICT for inclusive-education training guidance (beyond, but including, products) for countries, schools, caregivers, and community education leaders. Training programs could include:**

- ⊕ ICT for inclusive-education learning modules with the aim to raise awareness and support teachers and community leader) through online access to basic information about the needs of learners with disabilities. Supplement with knowledge resources and tools.

- **Enhance the development and implementation of policy on ICTs for inclusive education by providing technical assistance at country level, specifically:**

- ⊕ Support the integration of technology and education policies. These

practices are currently rare and providing examples and case studies of effective implementation could be beneficial.

- ⊕ Facilitate mechanisms for the identification of a single point of responsibility at the ministerial level to avoid cross-ministry proliferation and duplication, coupled with better data to support decision-making. (See also recommendation 4.)

- ⊕ Support the integration of inclusive-education technology requirements in National Disability Action Plans.

- ⊕ Consider contextually relevant targets and indicators around ICT for inclusive education in National Development Plans and loan agreements. (See also recommendation 4.)

- **Support teachers and other education providers in delivering inclusive educational experiences through:**

- ⊕ Ensuring that pre-service teacher training curriculum includes mandatory component on inclusive education with a focus on ICT.
- ⊕ Developing learning packages that support the “catch up” of previously excluded children and young people (adapting existing packages to be inclusive, as necessary.)
- ⊕ Digital products for catch up can be more broadly developed and adopted.
- ⊕ Non-official teaching staff (families and community leaders) can play a vital role; tools support should be offered to the broadest group possible.

<sup>14</sup> Tools, such as the [Country Capacity Assessment tool](#) developed by WHO and AT2030, could be used as starting points.

## RECOMMENDATION 2

**Develop a massive-small technology and service infrastructure for inclusive education to enable massive-scale distribution of evidence-based, small-scale innovations. It can be accomplished through the following:**

- **Drive innovation in ICT for inclusive education, which is needed at global, regional, national, and local levels to:**

- ⊕ Raise awareness of ICT for inclusive education as an investment space.
- ⊕ Create partnerships of unusual and disruptive actors and those with case studies of success (even in adjacent fields); incentivize teamwork; and include users of series (teachers and students).
- ⊕ Support awareness of new products and services by purchasers, educators, learners, and their families and address the issue that many educators remain unaware of what the market is already offering.

- **Design and test novel funding mechanisms to support existing innovators that respond to the need to support “massive-small” initiatives:**

- ⊕ Look to spotlight and scale the best practices spotted through this work at very small scale—under 1,000 children. Often carried out by community workforce, these initiatives are by definition contextually aware, user-centered, and problem oriented.
- ⊕ This could include distributed (small) manufacturing of products—and best practice service examples—on a massive scale.

- ⊕ Design a funding mechanism that makes it possible to fund these organizations through smaller grants, and with more hands-on support to validate and “stand up” their organizational infrastructure to do business. This might include novel due diligence mechanisms, support to get insurance, monitoring and evaluation, or work carried out with greater scientific rigor.

- ⊕ Scale the impact on learners, as a model, supported by better data, instead of a single “unicorn” business or technology.

- **Incentive open innovation through:**

- ⊕ Developing mechanisms to facilitate and incentivize entrepreneurs to enter the sector, particularly supporting the creation of innovations in languages other than English.
- ⊕ Matchmaking between policy makers and purchasers (of technology and services) and producers, and between larger companies and smaller innovators.
- ⊕ Link suppliers to funded demand for products and services. (Linked to recommendation 1.)
- ⊕ Hold or create space for “open innovation” collaboration (rather than competition at all times) between supply-chain established corporates, innovators, service recipients and implementers, and policy makers.
- ⊕ Consider capacity building access to robust testing of new innovations.
- ⊕ Consider ICT for inclusive education as a strand when designing mainstream innovation support.



Source: Inclusive Education Initiative, World Bank.

### RECOMMENDATION 3

#### **Strengthen community, family, and out-of-school learning supports to ensure continuity of learning across different settings.**

Many children with disabilities, and many children in general during the pandemic, find themselves learning outside of school settings. Important considerations for ensuring continuity of learning across different settings include the following:

- Shifting provision mechanisms to ensure that the AT is associated to the child rather than the school can help children learn outside of school, but should not replace efforts to keep children in school.
- Opening up training and support mechanisms to community leaders and caregiv-

ers to facilitate the provision of education outside the school when needed.

- Working with parents, caregivers, children, and representative organizations to ensure they are involved in identifying the need for, and the development of, EdTech that is intended for their use. This will help to ensure that the right products support the right child.
- Developing clear multidisciplinary referral structures for early detection and intervention of impairments, with clearly delineated roles and responsibilities (e.g., at the community and district level.)
- Continuing to collect and share case studies of good practice of community and family-led schooling, considering what platforms are needed for support.

## RECOMMENDATION 4

### **Capture better data and evidence vital to policy making, identification of learners, early intervention, and mapping of progress.**

Better data and evidence can increasingly be captured using emerging technology. Initiatives to support this could include the following:

- Connecting different identification and service delivery mechanisms (for example, data from OPDs as first point of contact for disability identify cards) to broader services, including AT and EdTech to better capture data.
  - Strengthening the use of EMIS data as a tool for future planning, including the type of EdTech that might be required at the classroom level and as an entry point for identifying children who may need EdTech support.
  - Developing better identification and screening tools for children with disabilities. In line with World Bank, WHO, and UNICEF guidelines, children should be screened at regular stages starting from their first 1,000 days. The WHO is testing tools that can be delivered at the community level, but countries need more support to regularly carry out large-scale screening efforts.
- Building the global evidence base to address research and knowledge gaps. The following considerations should be central to future research:
    - ⊕ There is very little documented evidence of the impact of EdTech on children with disabilities in comparison to their classmates without disabilities. Data on this would help more targeted interventions, especially in the post-pandemic recovery period.
    - ⊕ Most of the documented evidence is based on the technology itself, rather than the process of inclusion (for which a child or children may need AT). More research is needed on how this takes place, what the barriers and facilitators are, which pedagogical approaches work best, and how it can be taken to scale.
    - ⊕ Lack of teacher training is highlighted in much of the literature, but there is little evidence of good practice in this area (pre- or in-service teacher training). A review of the evidence would provide a baseline and highlight areas of potential replicability.
    - ⊕ Most of the measures of impact focus on learning outcomes and other indicators of inclusion, such as participation, transition, and access to play, and their relationship to technology.



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A photograph of two young girls sitting outdoors, looking at a tablet. The girl on the left is wearing glasses and a dark sweater over a white collared shirt. The girl on the right is wearing a grey sweater over a white collared shirt. They are both focused on the tablet. In the background, there are green plants and a colorful striped vase.

# appendix A

## definitions & concepts

The following definitions are used in this report, A Landscape Review of ICT for Disability-Inclusive Education

Source: Shutterstock.

**Assistive products (AP).** APs are defined by the World Health Organization (WHO 2016, 1) as “any external product (including devices, equipment, instruments, or software), especially produced or generally available, the primary purpose of which is to maintain or improve an individual’s functioning and independence, and thereby promote their well-being.”

**Assistive technology (AT).** AT is defined by the WHO (2016, 1) as “the application of organized knowledge and skills related to assistive products, including systems and services.”

**Education technology (EdTech).** EdTech is the use of hardware, software, digital content, data, and information systems in education that supports and enriches teaching and learning and improves education management and delivery (World Bank 2021).

**Information and communication technology (ICT).** ICT includes any communication device or application such as radio, television, cellular phones, computers, satellite systems as well as network hardware and software and associated services (Khetarpal 2014).

**Universal Design for Learning (UDL).** The UDL approach to education research and design uses the following three core principles (CAST 2021):

- Providing students with multiple means of representation;
- Providing multiple means of action and expression; and
- Providing multiple means of engagement.

The following are among a range of technologies that can be used by and for students with disabilities:

**Accessible ICT for persons with disabilities.** This technology includes hardware, such as magnification devices,

e-book readers for persons with disabilities; software, such as screen readers; and mobile applications to enhance functional access to content and communication including voice recognition, magnification, object recognition, and apps for alternative and augmentative communication.

### **Adapted teaching and learning materials.**

These materials change how content is delivered and disseminated such that it can be used by children with different types of disabilities.

### **Mainstream educational technologies.**

These include personal computing devices; classroom teaching tools, such as electronic whiteboards; online class management and content delivery, including massive open online courses (commonly known as MOOCs) and e-books; mobile applications for learning; and web and video conferencing. These technologies and content need to be designed using universal access standards or have in-built features for accessibility needs (e.g., UDL).

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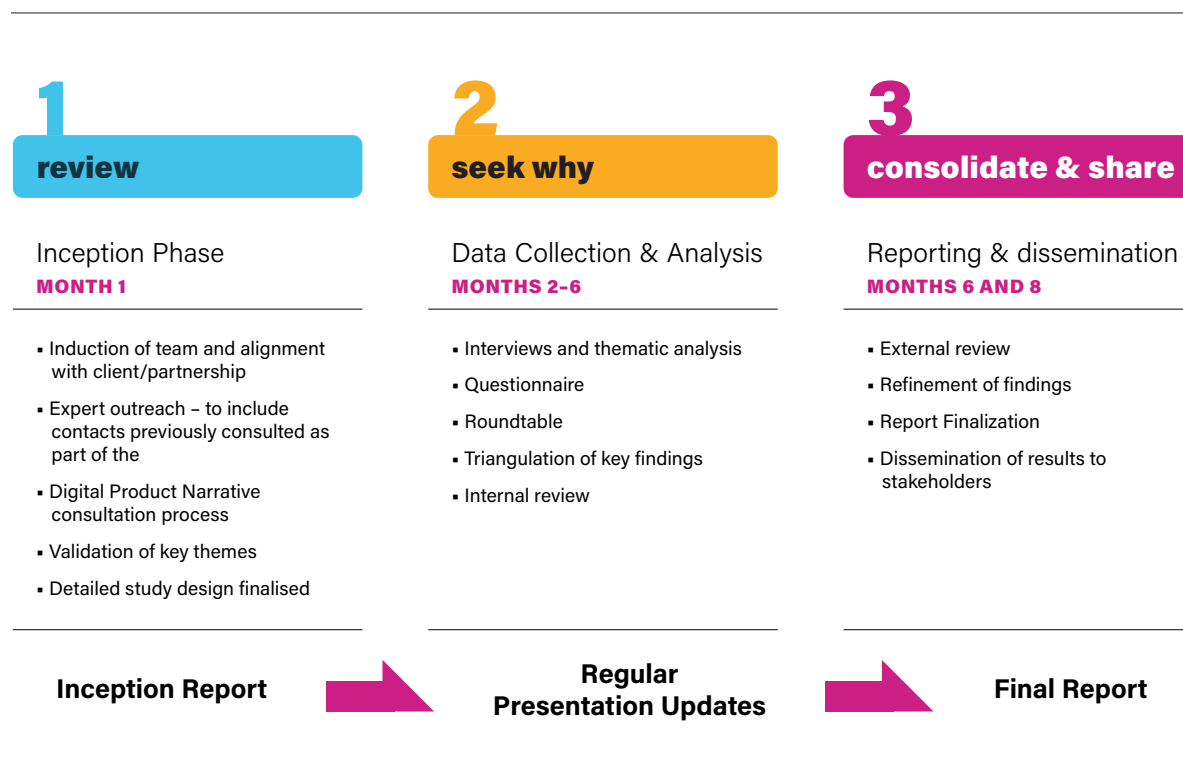
## appendix B

# detailed methodology

The study was conducted in three stages: (i) review, (ii) seek why, and (iii) consolidate and share (figure B.1).

Source: Inclusive Education Initiative, World Bank.

**FIGURE B.1: Overview of the three phases of the methodology adopted for the project comprehensive of individual steps undertaken for each phase of the research**



Source: World Bank 2021.

- **Review.** This involved undertaking a thematic review of findings from published academic and grey literature to identify what is already known, including innovation ideas in the public domain, and where there are knowledge gaps. In addition, four roundtable workshops were held with a total of 23 World Bank staff from the Education, Social Sustainability and Inclusion, and Digital Development Global Practices to identify existing resources, particularly within case study countries, as well as present and discuss findings. These were invaluable in both identifying potential interviewees in county, as well as to share findings and seek consensus around recommendations.
- **Seek why.** This involved undertaking a global online survey, an AI-powered scrape, and a total of 75 interviews across the five countries to seek to understand the challenges and opportunities around EdTech for children with disabilities. Six expert roundtables were conducted (online), once at the beginning of the research and another to present and discuss emerging findings about two-thirds of the way through.
- **Consolidate and share.** At the study's end, findings were shared with a range of stakeholders to disclose evidence and build consensus and buy-in for recommendations and next steps.



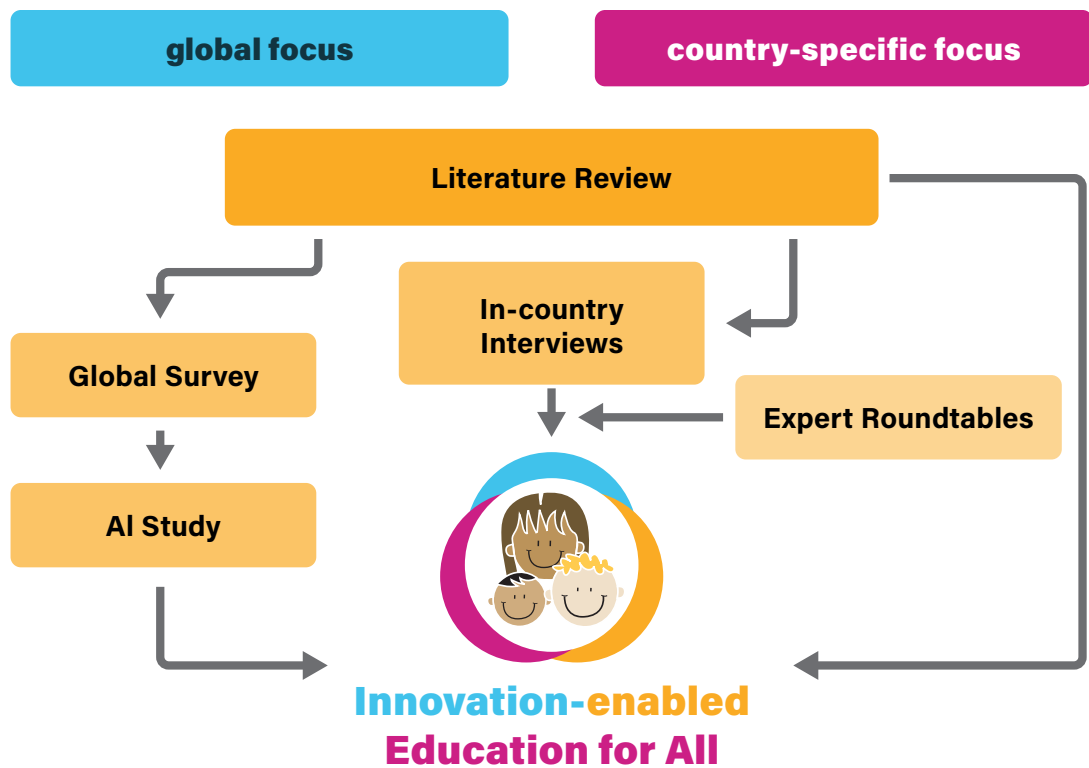
## methods

The study used several methods to answer the research questions, comprising:

- a literature review of available evidence;
- six expert roundtable discussions using an adapted Delphi approach;
- a global digital survey of stakeholders;
- an AI-powered media search; and
- key informant interviews in the five countries.

Figure B.2 shows how research methods were combined to present comprehensive recommendations for increasing access and the impact of ICT for inclusive education.

**FIGURE B.2: Project overview**



Source: World Bank 2021.

## literature review

A literature review, while not intended to be a systematic review, offers a comprehensive summary of key debates, issues, frameworks, and approaches in both the inclusive education and EdTech sectors, as well as where and how they converge, and where they do not for each country.

Given a recent systematic review of the literature pertaining to the learning outcomes of students with disabilities related to EdTech (Lynch, Singal, and Francis 2021), this review focuses primarily on the country-level literature, including grey and policy-focused literature, to complement the primary research data. Background literature to contextualize the country-level literature was also obtained through a search of academic databases and search engines (e.g., Google and Google Scholar), using related search terms (sometimes in combination) based on the parameters of the research and collated using Zotero reference manager. Only literature focusing on low- and middle-income countries in English and published between 2010 and 2020 was included. In total, 80 relevant articles and 20 reports were identified and included. A manual search of policy-focused and grey literature for the five countries (Bangladesh, Ethiopia, Kenya, Nepal, and Rwanda) was undertaken through online databases (e.g., Google, Google Scholar and ResearchGate), using the terms “inclusive education,” “COVID impact on children with disabilities,” “COVID impact on education for children with disabilities,” “EdTech for children with disabilities,” “primary school children with

disabilities,” “law and policies for children with disabilities,” and “ICT and disability policies.”

The country-level literature review findings are structured around the three key three conditions that Banes et al. (2020) recommended for the successful application of a UDL framework, which overarch and encompass the 6 P’s education systems framework and take into account the need for an approach that focuses on inclusive education. This framework provides a cohesive narrative from the data and best facilitates the identification of gaps and trends in country-level provision. The UDL framework’s three key conditions are as follows:

- identify children with disabilities using at a minimum the Washington Group questions);
- assess and understand the existing educational system in terms of capacity of policy, infrastructure, and educators to support the learning of children with disabilities; and
- provide affordable, accessible assistive technology (must be identified and assessed appropriately).

The full report of the literature review is available upon request from the report authors. A summary of key findings and themes are presented in chapters 3 and 6 of the main report.

To facilitate presentation and enable a more comprehensive understanding of the strengths and weaknesses of different components of the education ecosystem, these themes were organized according to the 6 P’s framework (see figure B.3).

**FIGURE B.3:** Education system 6 P's framework diagram



Source: Plaut et al. 2020.

The framework breaks down different aspects of the education ecosystem that influence the potential success or failure of ICT for inclusive-education interventions. The phrasing of the six questions in the original framework were slightly adapted in *A Landscape Review of ICT for Disability-Inclusive Education* to fit better the aim of understanding the complexity of developing and deploying EdTech to support inclusive education for learners with disabilities at a primary school level:

- **People.** Who uses and creates ICT for inclusive education?
- **Products.** What kinds of ICT for inclusive education is developed and used?
- **Pedagogy.** On which pedagogical principles is ICT for inclusive education built?
- **Policy.** How do existing policy frameworks influence ICT for inclusive education?
- **Place.** Where is ICT for inclusive education used?
- **Provision.** How is ICT for inclusive education funded, and how sustainable are current provision models?

## global online survey

The online anonymous survey comprised of 24 close-ended questions<sup>15</sup> and was designed to elicit responses around innovation pathways for ICT for inclusive education, availability and access of ICT for inclusive education, and experiences concerning the use and impact of ICT for inclusive education from a range of respondents, including:

- parents and caregivers of children with disabilities in or at primary school level;
- service providers, including nongovernmental organizations (NGOs) and disability service providers;
- technology providers;
- teachers and educators; and
- government stakeholders.

The digitalized survey data were collected through the Qualtrics platform, routinely used for secure and anonymous data collection by the University College of London (UCL) School of Psychology and Language Sciences.

The survey was conducted in English between May 10 and May 25, 2021. It was distributed through several professional groups and mailing lists, including the Global Cooperation on Assistive Technology listserv, the Australian Rehabilitation and Assistive Technology Association network, the Inclusive Education Initiative LinkedIn Group, and the Educause listserv, as well as social media and targeted emails to potential stakeholders and relevant organizations. The survey received 269 responses in total, of which 43 were incomplete and not included in the analysis. A total of 226 respondents completed the survey.

Quantitative data were analyzed using descriptive statistics, whereas qualitative responses were analyzed using an inductive open coding approach to build a taxonomy of EdTech based on the function of different types of technology mentioned by respondents. Full categorization of all the EdTech examples provided by participants was completed after four iterations of progressive coding where different types of technology were aggregated in broader categories based on their function and/or technical characteristics. This resulted in a full taxonomy of 12 categories and 35 sub-categories of EdTech which were used to determine the search terms for the AI study.

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<sup>15</sup> The questionnaire is available online at [insert URL before design].



## AI-powered media and academic article research

This piece of work was designed to understand the research trends in ICT for inclusive education topics and to identify media interest in these topics.

It was conducted in partnership with the Department for Artificial Intelligence, Jozef Stefan Institute, and the Department for Computer Science, UCL. This was enabled through a partnership between the Global Disability Innovation Hub (GDI Hub) and the International Research Centre for Artificial Intelligence of the United Nations Educational, Scientific, and Cultural Organization. Specific thanks to M. Beshar Massri and Marko Grobelnik from the Jozef Stefan Institute and Mo Wen and Sahan Bulathwela from UCL are recorded for providing their inputs.

### search methods

Two searches were completed. The first searched the academic literature using the [Microsoft Academic Graph](#) (MAG). MAG contains scientific publication records, citation relationships between those publications, as well as authors, institutions, journals, conferences, and fields of study. It is used to power experiences in Bing, Cortana, Word, and in Microsoft Academic and is updated weekly.

The second search was of media articles and uses the infrastructure which powers Event Registry. Event Registry is a system which analyses news articles. It can identify groups of articles that describe the same event across a range of languages, and

from these articles core event information can be extracted (Leban et al. 2014). This information is stored in database which can then be interrogated to inspect individual events or instances of terms (Leban et al. 2014). Event Registry uses Wikipedia as a training set of data from which to then search the internet for new articles (Rupnik et al. 2016). The taxonomy developed through the global survey was used to search Wikipedia and train the search across media articles for news events relating to these products. The data will be incorporated into the [AI & Assistive Technology in Media watch](#) to continue to track media events across the taxonomy. Media articles were limited to 3 years.

In both instances, a search was completed for “assistive technology” as a topic or phrase and then the taxonomy of 12 categories and 35 sub-categories were used to search the corpus. Each category and sub-category were mapped to a wiki “concept” with the same name and derivatives in different languages. To prevent double tagging sub-categories were searched, with categories being populated from these sub-categories. An analysis of these data is reported in chapter 5 of the report. It covers overall trends in both databases, with additional analysis of the geographic spread of data for academic data.

### expert roundtables

To elicit expert opinions from across a range of sectors and to ensure consensus around findings, four focus group discussions were undertaken with a total of 23 relevant World Bank staff, working on the selected countries; additionally, two online roundtable discussions with 24 selected

global experts in the fields of inclusive education, educational technologies, and disability, were completed using a modified Delphi described below. This approach was selected to illicit stakeholder views and build toward a collective position.

The modified Delphi approach included asynchronous and synchronous activities to identify and build consensus around the prioritization of key challenges under each of the 6 P's. A consensus building exercise was structured in two parts. Initially the selected panel of global experts was presented with a video presentation that outlined the findings from the interviews. Using a custom-made survey, experts were then asked to individually rank the main findings in order of importance and select what they identified as a key challenge under each of the 6 P's of the framework. In the synchronous session, researchers presented the resulting ranking of challenges based on the individual votes submitted by the experts and consensus on prioritization was reached through global discussion. At the end of the session, experts were also asked a set of questions to forecast future outcomes and explore actions and initiatives that could help to improve accessibility and impact of ICT for inclusive education.

Finally, two internal research team workshops were held with thematic experts on EdTech and inclusive education focusing on the extrapolation of implications around the future of EdTech based on the results emerging from both primary and secondary research. To ensure alignment with the broader World Bank strategy, two feedback and review sessions with the Bank staff team supporting this research were also completed.

## country-level interviews

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### Methodological Approach

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Semi-structured interviews with key informants from a variety of organizations were conducted across the five countries. Interviewees were identified through a collaborative process between GDI Hub and the World Bank with the decision of who to interview based on representativeness, availability of relevant participants and strength of existing connections to maximize recruitment.

The key informants recruited for the study worked for a variety of national and international organizations operating in the five countries. These included relevant government ministries and agencies (including Ministries of Education, Information and Communication Technologies, Social Welfare and Local Government), NGOs and INGOs, organizations of persons with disabilities (OPDs), OPDs, Donor Agencies, academia, private ventures and start-ups, as well as teachers and parents' groups. In total semi-structured interviews with 75 stakeholders across the five countries were conducted: Bangladesh (14); Ethiopia (10); Kenya (15); Nepal (16) and Rwanda (21) respectively.

Questions ranged from organizations' ongoing activities to support the inclusive education of children with disabilities; use of ICT and EdTech to support inclusive education both at an organization and national level; awareness of relevant policy frameworks; initiatives to support the use of EdTech for the benefit of learners with disabilities; evaluation mechanisms to

assess the inclusion level and the impact of different programs; collaborations with national and international partners and the use of ICT; and EdTech resources to support the education of primary school learners with disabilities during the ongoing COVID-19 pandemic.<sup>16</sup> Separate interview guides were prepared for stakeholders working in government organizations and these included additional questions about the internal collaborations between different government departments; and the allocation of responsibilities in relation to the implementation of inclusive education programs leveraging technology.

Five local consultants were recruited (one in each country) to undertake interviews in local languages, where necessary, and to facilitate in-person interviews, where possible due to COVID-19 restrictions. The consultants underwent a two-stage training on the process, tools, and getting consent, as well as a practice interview with the core team. Local researchers were accompanied by one of the core research team members for some virtual interviews to ensure quality and consistency.

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## Interview Procedure

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All participants were sent both an information sheet about the study and the consent form (available in physical or digital format) to read and complete ahead of the interview and they were invited to ask questions if they found anything unclear. At the start of each interview, before commencing the recording, the researcher asked participants to confirm they had signed the informed consent and that they were happy for the interview to be recorded for the purpose of analysis.

Interviews were conducted between May 13 and August 14, 2021. The majority of interviews were carried out in English, but some were undertaken in local languages according to participant preferences. These were then translated and transcribed by the local researchers. The majority of the interviews were conducted individually via video conferencing software. However, on two occasions (once in Nepal and once in Rwanda) participants working in different branches of the same government ministry were interviewed together to provide a more detailed and coherent picture of the work of a particular ministry or agency in the context of ICT for inclusive education. Two stakeholders in Ethiopia stated that they did not have access to a stable enough internet connection to take part in an online interview and decided to provide answers in writing. Three stakeholder interviews in Rwanda were conducted in person according to participants' preferences and in-line with government guidelines. Sign language interpretation was organized by the research team to enable two stakeholders from relevant organizations who were sign language users to take part in the study.

All in-person and remote interviews were audio recorded by the researchers using portable external devices rather than third party cloud storage to ensure compliance with General Data Protection Regulation guidelines. Audio recordings were transcribed verbatim in the language of the interview and translated to English when necessary. These were then uploaded to a dedicated Microsoft Team (a dedicated Microsoft Teams Group was created for each country) and stored securely on UCL systems.

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<sup>16</sup> The questionnaire is available online at [insert URL before design].

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## Data Analysis

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Transcripts of interviews and written responses provided by participants were analyzed by the lead researcher using reflexive thematic analysis (Braun and Clarke 2006, 2019). The approach used was a hybrid with an initial deductive approach that leveraged the 6 P's framework for analysis, as shown in figure B.3 (Plaut et al. 2020). The findings are presented against this framework.

Within each area of the 6 P's framework, an inductive approach was used to develop data-driven themes that outlined the specific factors influencing various aspects of the education and technology ecosystem. Moreover, under each P, country-specific snapshots are produced to highlight the contextual differences between each country. Due to the objective nature of the research, the analysis is focused on the semantic interpretation of accounts provided by participants during the interviews. Themes were further discussed with World Bank staff and global experts working in the field of inclusive education to ensure that the interpretation matched experiences of the field.

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## Participant Characteristics

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The key informants recruited for the study worked for a variety of national and international organizations operating in the five countries. These included relevant government ministries and agencies (including ministries of education, information and communication technologies, social welfare, and local government), NGOs and international

NGOs, organizations of persons with disabilities (OPDs), donor agencies, academia, private ventures and start-ups, and teachers and parent groups. In total semi-structured interviews with 75 stakeholders across the five countries were conducted: Bangladesh (14); Ethiopia (10); Kenya (15); Nepal (16); and Rwanda (21), respectively.

## ethics

The protocol for this study was granted ethical approval by the UCL Research Ethics Committee (ID number: 1661/013). All data collection, storage, and analysis procedures strictly followed the World Bank Group's [Policy on Personal Data Privacy](#).

## limitations

There are some limitations to this study. It only focuses on five countries and is not representative of the entire global picture. However, the countries were chosen in part to reflect the diversity of case, and this study complements the recent comprehensive systematic review by Lynch et al. (2021), and builds on gaps identified therein. Nevertheless, many of the challenges and opportunities identified resonate across several different contexts and as such the recommendations are relevant to the global context.

A second limitation is that the secondary research was undertaken in English, reflecting a predominance of English language resources in the literature. Future studies might encompass a broader range of languages.



The majority of the research was conducted virtually, working with local consultants due to the ongoing COVID-19 pandemic crisis in many of the countries at the time. This means that only people who had access to the internet or access to a phone could be involved in the research. However, where possible national OPDs and other civil society organizations were included in order to ensure a broad range of representations. In Ethiopia, the team had limited access to officials due to constraints on their time resulting from other emergency situations.

Finally, it should also be noted that the EdTech field in particular is a rapidly evolving one, and naturally resources for a study such as this are limited. Especially in the light of the ongoing COVID-19 pandemic, which is still impacting education and learning globally, the evidence included here was up to date at the point of writing but will inevitably continue to evolve.

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## appendix C

# expert roundtables and consultations

The team is grateful for colleagues from the World Bank and many of our development partners that graciously shared their knowledge and insights through the expert consultations.

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## External

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**Alana Laudone**, Benetech

**Aleksandra Jovic**, UNICEF, Europe and Central Asia Regional Office

**Anne Hayes**, Inclusive Development Partners

**Anthony Bloome**, mEducation Alliance

**Brad Turner**, Benetech

**David Banes**, Independent Consultant on Education through Technology

**Freya Perry**, FCDO

**Irene Mbari-Kirika**, inABLE

**Joshua Josa**, USAID

**Julia McGeown**, Humanity and Inclusion

**Lena Olsen Sømme**, Norad

**Marie Schoeman**, Leonard Cheshire

**Mark Carew**, Leonard Cheshire

**Mohammed Ali Loutfy**, G3ict

**Pamela Molina**, World Federation of the Deaf

**Richard Orme**, DAISY Consortium

**Sandra Boisseau**, Humanity and Inclusion

**Sandrine Bohan Jacquot**, Humanity and Inclusion

**Sian Tesni**, CBM

**Will Clurman**, eKitabu

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## World Bank

---

**Alicia Hammond**, Gender Specialist

**Anna Olefir**, Senior Education Specialist

**Annet Wanjira Kiura**, Education Specialist

**Annette Omollo**,  
Social Development Specialist

**Cindy Ijeoma Ikeaka**,  
Social Development Specialist

**Dario Zanardi**, Social  
Development Specialist

**Dewi Susanti**, Senior  
Social Development Specialist

**Edda Ivan-Smith**, Senior Social  
Development Specialist

**Gloria Malia Mahama**, Senior Social  
Development Specialist

**Hala Ballout**, Social Development  
Specialist

**Huma Kidwai**, Senior Education Specialist

**Jaya Sharma**, Senior  
Social Development Specialist

**Karthika Radhakrishnan-Nair**, Senior  
Education Specialist

**Maria Elena Garcia Mora**, Senior Social  
Development Specialist

**Sanjay Agarwal**, Senior Social  
Development Specialist

**Tashmina Rahman**, Education Specialist /  
Dhaka

## appendix D

# about the global disability innovation hub

The Global Disability Innovation Hub (GDI Hub) is a research and practice center driving disability innovation for a fairer world. Operational in 41 countries delivering over 35 projects across a portfolio of £50 million, GDI Hub has reached 4 million people since 2018 by developing bold approaches, partnerships, and ecosystems to accelerate change.

With solutions-focused experts in disability innovation, GDI Hub delivers world class research, teaching, innovation, programs, and advocacy amplifying community-led solutions to shape mainstream programming. More than a product, service, or policy, disability innovation is a way of thinking to address intractable challenges by co-designing answers and sharing knowledge.



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